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MODERNIZATION OF DOMESTIC FOOD CHAINS IN DEVELOPING COUNTRIES: WHAT EFFECTS ON SMALL-SCALE FARMERS?

The rice value chain in Senegal

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ABSTRACT

The debate about the contribution of domestic food chains to national food security in developing countries was revived by the last food price crises. In Asia, midstream enterprises implement technical changes and integrate new functions, resulting in increased added value and lower prices for consumers. The general objective of the thesis is to contribute to knowledge about the organization of domestic food value chains in Africa and their economic and social implications for small-scale farmers. It addresses three issues. First, it analyzes the organization of the rice value chain in Senegal to determine if it follows the same modernization pattern as the Asian one. Second, the thesis examines the inclusion of small-scale producers in contract farming, with a specific focus on the combination of marketing modes. Third, the thesis assesses the impacts of contracts on small-scale farmer incomes and food security. The theoretical framework is the governance of the Global Value Chain, which analyzes the influence of the driver of the quality on the distribution of tasks and skills among the actors of the chain. It is combined with the theoretical frameworks of plural forms and livelihoods to address the second issue. The case studied is the Senegal River Valley rice value chain. Data analyses are based on 154 qualitative interviews and a body of quantitative data involving over 913 actors in the value chain. Producer participation in contracts is analyzed with a multimodal logit model and the selection bias is corrected with instrumental variable and propensity score models. The first result is that modernization of the Senegalese value chain is in step with what is taking place in Asia. Nevertheless, in Senegal, (1) the benchmark situation is a spot transaction (and not a tied credit-output transaction), and processors carried out paddy collection before the modernization, (2) credit policies directly contribute to the change in governance, and (3) the modernization of the rice value chain does not make it competitive relative to imports of broken rice. The second result is that small-scale producers participate in contracts to secure agricultural financing. The segmentation of the credit market is linked to the indebtedness of small-scale producers to the national agriculture bank. Uncertainty is a second order driver towards plural forms. Besides, producers continue marketing through spot transactions which can be adapted to household needs. The third result is that the impacts of contracts on small-scale farmers are different. The marketing contract is a financial device which has no impact on agricultural practices, yields, product quality and income. It nevertheless slightly improves food security by mitigating price seasonality. The production contract has a positive impact on the income of producers who were excluded from bank credit. It nevertheless includes implicit interest and insurance costs, meaning that these producers make less profit than those financed by the bank. In order to support the modernization, policies should enhance the design of an appropriate insurance system for agricultural

credit. They should also include small-scale processors in the modernization through the promotion of semi-industrial techniques and the opening up of operating and equipment loans. Finally, they should fund studies about the use of small-scale mechanization.

RÉSUMÉ

Le débat à propos de la contribution des chaînes de valeur domestiques à la sécurité alimentaire nationale dans les pays en développement a été ravivé par les dernières crises alimentaires. En Asie, les entreprises du segment intermédiaire réalisent un changement technique et intègrent de nouvelles fonctions, ce qui provoque une augmentation de la valeur ajoutée et un prix de vente au consommateur plus bas. L'objectif général de cette thèse est de contribuer à la connaissance de l'organisation des chaînes de valeur alimentaires domestiques en Afrique et leurs implications économiques et sociales pour les petits producteurs. Elle traite trois questions. Premièrement, la thèse analyse l'organisation de la chaîne de valeur du riz au Sénégal dans le but d'estimer si elle connaît une modernisation similaire à celle observée en Asie. Deuxièmement, la thèse examine l'inclusion des petits producteurs dans l'agriculture contractuelle, avec un intérêt particulier pour la combinaison de modes de commercialisation. Troisièmement, la thèse évalue l'impact des contrats sur les revenus et la sécurité alimentaire des petits producteurs. Le cadre théorique est celui de la gouvernance des Chaînes Globales de Valeur, qui analyse l'influence du pilote de la qualité sur la répartition des tâches et compétences entre les acteurs de la chaîne. Il est combiné avec les cadres théoriques des formes plurielles et des moyens d'existence pour traiter la seconde question. Le cas étudié est celui de la chaîne du riz dans la vallée du fleuve Sénégal. Les analyses de données sont basées sur 154 entretiens qualitatifs et des données quantitatives concernant 913 acteurs de la chaîne de valeur. La participation des producteurs dans les contrats est analysée par un modèle logit multinomial, et le biais de sélection est corrigé avec les modèles de la variable instrumentale et de l'appariement au score de propension. Le premier résultat est que la modernisation de la chaîne de valeur du riz du Sénégal est similaire à celle ayant lieu en Asie. Néanmoins, au Sénégal, (1) la situation de référence est une transaction spot (et non une transaction dans laquelle les intrants et le produit sont liés), et les transformateurs réalisaient la collecte du paddy avant la modernisation, (2) les politiques de crédit contribuent directement au changement de gouvernance et (3) la chaîne de valeur moderne n'est pas compétitive par rapport aux importations de riz brisé. Le second résultat est que les petits producteurs participent aux contrats afin de sécuriser le financement agricole. La segmentation du marché du crédit est liée à l'endettement des petits producteurs auprès de la banque nationale. L'incertitude est un déterminant de second ordre des formes plurielles. De plus, les producteurs commercialisent aussi le paddy par des transactions spots qui peuvent être adaptées aux besoins du ménage. Le troisième résultat est que les impacts des contrats sur les petits producteurs sont différents. Le contrat de commercialisation est un dispositif financier qui n'a pas d'impact sur les pratiques agricoles, les rendements, la qualité du produit et le revenu. Néanmoins,

il améliore légèrement la sécurité alimentaire par l'atténuation de la saisonnalité des prix. Le contrat de production a un impact positif sur le revenu des producteurs exclus du crédit bancaire. Néanmoins, il inclut des coûts implicites d'intérêt et d'assurance qui impliquent que ces producteurs obtiennent un profit moins important que celui des producteurs financés par la banque. Dans le but de soutenir la modernisation, les politiques publiques devraient favoriser l'élaboration d'un système d'assurance approprié au crédit agricole. Elles devraient aussi inclure les petits transformateurs dans la modernisation par la promotion de techniques semi-industrielles et l'ouverture de crédit au fonctionnement et à l'équipement. Elles devraient finalement financer la réalisation d'études quant à l'utilisation de la mécanisation à petite échelle.

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OUTLINE

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ACRONYMS

AB	Agro-business (Fr)
ATT	Average Treatment effect on the Treated
CARD	Coalition for African Rice Development
CIRAD	Centre de coopération Internationale en Recherche Agronomique pour le Développement
CNCAS	Caisse Nationale de Crédit Agricole du Sénégal
CPSP	Caisse de Péréquation et de Stabilisation des Prix
FAO	Food and Agriculture Organization of the United Nations
FCFA	Franc de la Communauté Financière en Afrique
GVC	Global Value Chain
HFIAS	Household Food Insecurity Access Scale
IV	Instrumental Variable
kg	kilogram
PSM	Propensity Score Matching
SAED	Société d'Aménagement et d'Exploitation du Delta
SRV	Senegal River Valley
TCE	Transaction Costs Economics
USAID	United States Agency for International Development
VC	Value Chain
VFS	Vallée du Fleuve Sénégal

CHAPTER 1: GENERAL INTRODUCTION

Part of the general introduction was presented at the 140th seminar of the European Association of Agricultural Economists: Soullier, G., and Moustier, P. (2013) "The dominance of relational governance in african food value chains: a long way towards the asian quiet revolution?" In *140th Seminar of the European Association of Agricultural Economists*, 13. Perugia, Italy, December 13-15, 2013.

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The Millennium Development Goals were established by the United Nations in 2000 in order to "capture the promises of globalization while managing its adverse effects" (Annan, 2000, p12). The first goal was to eradicate hunger and extreme poverty through economic growth. Fifteen years later, although considerable effort has been made and much progress achieved, "the poorest and most vulnerable people are being left behind" (United Nations, 2015, p4).

Poverty reduction has been less significant in Africa than in other parts of the world. In 2013, 767 million people lived on less than $1.90 per day around the world (Cuesta et al. 2016). Poverty has been reduced by 35% since 1990, but progress was mainly observed in East Asia and the Pacific. The reduction was much less significant in sub-Saharan Africa, where it decreased by only 4 million to reach 389 million people in 2013. Furthermore, the number of undernourished people in sub-Saharan Africa increased to 239 million between 1990 and 2010 (Ghanem, 2010). Since 80 percent of the world's poor lived in rural areas in 2013 and 64 percent of them worked in agriculture (Cuesta et al., 2016), agricultural livelihoods should be targeted to reduce poverty (Loayza and Raddatz, 2010; Valdés and Foster, 2010; World Bank, 2008; Ligon and Sadoulet, 2007).

Value chain (VC) approaches can support producers in increasing their income and thus reduce their monetary poverty. These approaches enable us to analyze how producers can be connected to remunerative markets (World Bank, 2008). The functional definition of a VC is "the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), to delivery to final consumers, and final disposal after use" (Kaplinsky and Morris, 2001, p4).

The general objective of the thesis is to contribute to knowledge about the organization of food VCs in Africa and their economic and social implications for small-scale farmers.[1] Contributing to this debate may enlighten policymakers about pathways from VC organization to income generation by these producers.

In the general introduction to this thesis, I first present the issues, then the theoretical framework, followed by the research questions and hypothesis. I then briefly present the case studied and the methods used to deal with these questions. I finally present the main outline of the thesis.

[1] "Small-scale farmers" is a term used, like "family farmers" or "small-scale producers" to describe farms in which capital, labor and production are managed by a family. Assets and areas farmed are limited, the legal status is sometimes informal and a part of the production is self-consumed (Bosc et al., 2015).

1. Context

The organization of domestic food chains in Africa and Asia was documented in the 1990s. Some research reveals that VCs are traditional[2] and display a weak performance (Goossens et al., 1994). They operate within uncertain institutional environments, characterized by deficient policies, low-quality infrastructures, climate conditions and insecurity (Hugon et al., 1995). They involve numerous intermediaries and producers that depend on traders through tied credit-output linkages. Transactions are based on relational and physical proximity which enables the parties to share the risks and benefits. All actors use simple technologies[3] and supply undifferentiated products of variable quality (Fafchamps, 2004; Moustier et al., 2002; Chaléard, 1996; Hugon et al., 1995; Drakakis-Smith, 1991; Hugon, 1988; Altersial/cered, 1986; Lele, 1971). But some research indicates that domestic food chains are able to supply cities in a competitive way (Duteurtre, 2007; Cadilhon et al., 2006; Fournier et al., 2002). There are few barriers to entry and collusion patterns leading to market concentration (Bauer, 1955). Price variations are mostly due to the seasonality of production and the lack of transportation connections. The coordination of transactions through stakeholder networks may be more transparent than through markets characterized by imperfect information and uncertainty (Galtier, 2002). Traditional VCs provide outlets for heterogeneous products from small-scale producers and inexpensive food for poor consumers (Guarín, 2013). Nevertheless, VC actors use simple technologies and innovation is limited due to a low price incentive on end markets (Jones, 1970, 1974).

The intensification of agriculture took different forms in Asia and Africa. In Asia, policies fostered the "green revolution" (Birner and Resnick, 2010; Hazell, 2009). Access to improved inputs such as high-yield varieties and synthetic fertilizers was facilitated and subsidized, as was access to agricultural credit. The green revolution started in the mid-1960s in India, Indonesia and the Philippines and spread to other Asian countries during the 1980s. In contrast, the green revolution did not take place in most of sub-Saharan countries (Birner and Resnick, 2010). The multiple causes underlying this include unfavorable macroeconomic conditions (inflation and exchange rates), the limited capacity of governments, a lack of road and communication infrastructures, limited demand for high-quality products, heterogeneous and unfavorable natural conditions and non-adapted seed varieties (Frankema, 2014). Producers face

[2] I use the term traditional rather than informal. The difference between formal and informal VCs is the enforcement institution, which is or is not rooted in law and the constitution (North, 1990). In this thesis, the difference between the traditional and modern VCs is identified in terms of processing techniques and type of coordination mechanism.

[3] Technology is defined as the methods of production which have been developed or might be developed. Technique is the use of technology.

limited access to credit because of their lack of collateral security and their low risk-bearing ability (Bardhan, 1980). This prevents them from purchasing fertilizers and using machinery. Irrigated agriculture was not well developed.

The literature dealing with global food chains took shape with the globalization of the world economy. It documents the transformation of agrifood VCs and the associated impacts in developing countries (Reardon et al., 2009). This transformation was enhanced by liberalization policies, changes in demand (including increased income and urbanization) and investments from agrifood companies in new technologies. Wholesaling, processing and retailing became characterized by privatization, multi-nationalization, specialization and consolidation (Gutman, 2002; Reardon and Berdegué, 2002). This was particularly observed with the supermarket revolution and the development of modern fast-food restaurants (Reardon and Berdegué, 2002). Modern agrifood companies set up new types of coordination[4] to differentiate their products. These include private standards or grades of quality[5] and safety as well as vertical coordination[6] mechanisms such as contracts (Swinnen and Maertens, 2007; Reardon et al., 1999).

The debate about the contribution of domestic[7] food chains to food security and income generation was revived by the recent food price crisis. The global food price index was multiplied by a factor of 2.25 during the crisis[8] (Cuesta et al., 2014, based on World Bank data). The short-term policy response in several countries was to reduce tariffs and taxes and sometimes to subsidize food products (Wodon and Zaman, 2010). Nevertheless, it was not sufficient to offset the price surge, with the poorest households most affected (Kumar and Quisumbing, 2013; Cudjoe et al., 2010; Sundaram, 2010). Policymakers and researchers reopened the debate about the contribution of domestic food chains to national food security, but the literature addressing this question over the past two decades was in fact limited (Soullier, 2013).

[4] Coordination is the ability to provide direction and enforce instructions with regard to other actors in the VC (Arshinder et al., 2008).
[5] Quality is "the capacity of a set of attributes to satisfy requirements" (AFNOR, 2005, p1) - Translation by the author.
[6] Vertical coordination refers to the "make-or-buy decision" handled by Transaction Costs Economics.
[7] "Domestic chains" refer to VCs operating within a country. I prefer this term to "local" chains because they may operate at large geographical scales within the same country.
[8] Between 2006 and the peaks of the crisis which occurred between July 2007–June 2008 and June 2010–February 2011.

The Asian Development Bank commissioned the International Food Policy Research Institute (IFPRI) to study the capacity of domestic food chains to supply cities. Its work documents the modernization[9] of the rice and potato chains in India, Bangladesh and the People's Republic of China (Reardon et al., 2014, 2012a). Contexts and drivers of the modernization are heterogeneous, but the highlights are as follows: Demand for higher-quality products increased with urbanization, rising income and diet changes; policies created a favorable environment through investment in road and electricity infrastructure and through the opening of domestic markets to foreign investment; farmers were still supported by research and extension and, sometimes, subsidies to purchase seed or fertilizer.

Thanks to the green revolution, which increased rice yields from 1.86 t/ha to 4.18 t/ha between 1961 and 2006, Asian production increased from 200 million tons to 570 million tons (FAO data used by CARD, 2009). Actors from the midstream segment invested in new techniques providing higher-quality products and higher yields. They also integrated the function of product collection and sometimes set up contractual transactions. Tied credit-output market relationships disappeared thanks to farm diversification (Reardon et al., 2014). Changes downstream tended toward the supermarket revolution (Reardon et al., 2014; Reardon and Minten, 2011). The quality of the end product improved with cleanness, grading, packaging, branding and traceability. The total margin increased while costs decreased (Minten, Singh, et al., 2013; Minten et al., 2010). The change to quality products influenced the distribution of margins which became more advantageous for non-farmer actors, especially rice millers and warehouse operators. Producers did not benefit directly from higher retail prices, although they may get a slightly higher income in absolute terms (Minten, Murshid, et al., 2013; Reardon et al., 2012). [10]

2. Issues: An African modernization?

There are in certain African countries a number of contextual factors that are similar to those which fostered the quiet revolution in India, Bangladesh and the People's Republic of China. In addition to the price crisis, these factors concern the demand for food products and policies.

Changes in the demand for food products in Africa have been favorable to the modernization of domestic food chains over the last few decades. These changes were driven by two factors. First, growth in urban food markets (Reardon et al., 2015) resulting from urbanization in sub-Saharan Africa. It also

[9] Modernization is understood as investments in up-scaling and quality-improvement techniques which are coupled with new modes of coordination among the VC actors.
[10] The quiet revolution is outlined in chapter two.

results from the fact that urban consumers spend more than rural consumers on food. Indeed, the average amount is 78% higher in Burkina Faso and 148% in Mali (Hollinger, 2015). Finally, it results from the growth of the middle class (households living on 2 to 20 dollars per capita per day), which doubled in sub-Saharan Africa between 1990 and 2010 (Ncube et al., 2011). The second factor underlying the new food demand is the change in diet (Reardon et al., 2015). This transformation is characterized by an increase in demand for horticultural, livestock and processed products.

Contrary to Asian countries, the increase in agricultural production was fueled by the extension of farmed areas rather than yields. For instance, from 1961 to 2006, rice yields in Africa increased very little, from 1.24 t/ha to 1.78 t/ha (FAO data used by CARD, 2009). The increase in production from 3.14 million tons to 14.60 million was mainly fueled by the increase in areas farmed, from 2.5 million hectares to 8.2 million hectares. Nevertheless, this was not sufficient to offset demographic growth and the rice dependency ratio[11] increased from 20% in the 1960s to 45% during the 2000s (Mendez del Villar and Lançon, 2015).

Modernization policies introduced in Africa following the price crisis were inspired by the Asian green revolution (CARD, 2008). The World Bank produced the "Agriculture for Development" report, which recommends policies to intensify agriculture and improve the marketing of agricultural products (World Bank, 2008). The Food and Agriculture Organization (FAO), whose actions were reduced during liberalization, organized the World Summit on Food Security in June 2008. It concluded on the need to establish an international strategy to support agricultural production and trade (Bricas and Daviron, 2009). The Economic Community of West African States also implemented a regional program aimed at increasing agricultural production and improving processing and connection of farmers to remunerative markets (Fofana et al., 2014). Over the 2009–2017 period, the Coalition for African Rice Development[12] (CARD) aimed to increase African rice production from 14 to 28 million tons (CARD, 2008). These programs are implemented through national policies, such as the National Program for Rice Self-sufficiency in Senegal (MA, 2009), the National Development Strategy for the rice VC in Ivory Coast (MA, 2012), the National Rice Development Strategy in Nigeria (MFA, 2009) and the National Plan to Revitalize Agriculture in Benin (MAEP, 2010).

[11] The share of imported rice in total consumption.

[12] The Coalition for African Rice Development (CARD) is a consultative group bringing together African and international organizations as well as bilateral and multilateral donors. Its purpose is "to respond to the increasing importance of rice production in Africa and to provide the international framework to assist self-effort of African countries to increase rice production, building on the existing structures, policies and programs" (CARD, 2009, p1). It favors Africa-Asia cooperation to implement a green revolution in Africa, taking the Asian experience into account.

The priority of these policies is to increase the production of agricultural goods through intensification (Bricas and Daviron, 2009). Their aim is to increase yields by providing small-scale producers with access to technical packages to enhance yields, which include the use of high-yield seed, synthetic fertilizers and herbicides in addition to credit. Some "smart" subsidies may also be used. The development of irrigated land is also promoted. Large national and foreign companies are encouraged to invest in agriculture thanks to easy access to land (Ribier and Baris, 2013; World Bank, 2013). Finally, policies favor farmer access to mechanized services.

State intervention subsequently supported the processing and marketing segments (Hathie, 2016). The use of new technology was favored. By granting access to land and sometimes subsidies, large companies, such as Olam in Nigeria, were encouraged to invest in processing. Access to investment and operating credit was facilitated by national agricultural banks, such as in Senegal. Links with family farmers were favored to secure processor supplies, for example bilateral or tripartite contractual devices (FAO, 2015).

In that apparently favorable context, it is still unclear whether a modernization of domestic food chains is ongoing in sub-Saharan Africa. The literature on this topic has been limited since the start of the new millennium. The supermarket revolution never got off the ground in most of African countries (Tschirley et al., 2010) and the existing literature suggests a predominance of traditional VCs (Soullier, 2013; Duteurtre, 2007; Galtier, 2002). Domestic food chains still use little capital and supply heterogeneous-quality products generating low value added.

Nevertheless, there is also some evidence of the transformation of domestic food chains in Africa (Reardon et al., 2013, 2015). In Tanzania, the food system supplies a wide variety of locally processed, high-quality products which are competitive relative to imports (Ijumba et al., 2015). In horticulture food VCs in Rwanda, the emergence of contracts, direct relationships between producers and retailers and the integration of agricultural production by processors is observed (Verhofstadt and Maertens, 2013). Within the teff VC in Ethiopia, millers propose services such as cleaning which improve the quality of the end product (Minten, Tamru, et al., 2013). In Kenya, Zambia and Zimbabwe, there is an expansion of the maize processing segment, with investments in small and medium processing units (Jayne et al., 2010). Nevertheless, such evidence is still sparse (Hathie, 2016).

There are contextual factors in Africa similar to those in Asia which could favor the modernization of domestic food chains. Nevertheless, scientific evidence documenting such modernization is limited. For

these reasons, the first issue addressed is: **"To what extent can the quiet revolution be documented in Africa?"**

In recent years there have been large-scale private investments in the agrifood and agrifuel sectors in sub-Saharan Africa (Gatete and Dabat, 2014; Bauer et al., 2011). International or local companies set up new forms of coordination with small-scale producers, which are mainly contract farming and salaried employment. Schoneveld (2014) identified that between 2005 and 2013, investments integrating agricultural production concerned 22,727,457 ha in sub-Saharan Africa. On the other hand, "the proportion of farm households involved in contract farming is probably in the range of 1-5 percent" (Minot and Sawyer, 2016, p136, based on a literature review). Contract farming is more developed in certain countries, such as in Benin where contracts concerned 34% of cotton growers in 2005 (Minot and Daniels, 2005).

Contract farming is a coordination mechanism which is expanding around the world, especially in South and Southeast Asia and in sub-Saharan Africa.[13] It is defined as an agreement "between farmers and other firms, whether oral or written, specifying one or more conditions of production and/or marketing of an agricultural product" (Roy, 1963, cited by Rehber 2007, p33). It started under the industrialization paradigm (Swinnen and Maertens, 2007; Little and Watts, 1994), but most of its development was carried out by large private companies during liberalization (Prowse, 2013; Jaffee and Gordon, 1993). In a context of improvement in transportation, logistics, communication and changes in demand toward higher-quality products, those companies set up contracts and standards to secure their supplies. Literature considers that contract farming is an institutional device which reduces market failures in developing countries (Poole et al., 2003; Key and Runsten, 1999). It increases agricultural yields thanks to access to inputs such as improved seed, fertilizers and mechanized services in addition to credit. Contract farming also provides access to technical assistance and reduces markets uncertainties, for instance through the stability of marketing prices. It results in an improvement in product quality which provides access to more remunerative markets (Da Silva, 2005).

The development of contract farming raises the issue of poverty and inequality (Bricas and Daviron, 2009). Indeed, the implementation of new organizational devices between downstream actors and producers may include only a proportion of producers meeting the criteria required, thereby excluding the others. The first issue regarding the effects of VC modernization on small-scale producer incomes is

[13] For instance, 12% of Mozambique's population is involved in contract farming (Swinnen and Maertens, 2007) and 90% of cotton and milk in Vietnam is produced under contract (UN, 2009).

therefore the issue of inclusion.[14] The literature offers insights into the conditions of producer participation in contract farming in export chains of high value products. The firm proposes contracts to producers who are within their radius of activity and who comply with certain criteria (Barrett et al., 2012). They prefer farms with larger surface areas in order to reduce organizational costs (Kirsten and Sartorius, 2002; Key and Runsten, 1999). They also prefer land owners (Baumann, 2000), farms that are endowed with non-land assets (Barrett et al., 2012; Reardon et al., 2009) and diversified in non-agricultural activities (Birthal et al., 2005) in order to reduce the risk of non-reimbursement. These inequalities are nevertheless context-dependent and may be mitigated by the homogeneity of farm size, competition among purchasers, farmer organizations and policies (Barrett et al., 2012; Reardon et al., 2009). In this context, smallholders decide whether or not to work on a contractual basis according to their expectations in terms of access to credit, price premiums, input, information, economies of scale, risk reduction and knowledge acquisition (Bellemare, 2012; Key and Runsten, 1999; Poole et al., 1998).

More research is required on the drivers of small-scale producer participation in contract farming to define appropriate policies, particularly with regard to differences in farm characteristics. One particular limitation of that literature is that producers are considered as being included either in traditional VCs through market transactions or in modern VCs through contract farming. Nevertheless, participation in contract farming may be coupled with marketing to traditional VCs because both fulfill different and complementary functions. For instance, in addition to contract farming, which provides access to improved inputs and remunerative markets, participation in traditional VCs may provide quick payment (Masuka, 2012), access to credit for unexpected expenses and outlets for products rejected by contracts (Mujawamariya et al., 2013). Such a combination of marketing modes is sometimes cited in the literature, without any in-depth analysis being conducted (Rao and Qaim, 2011; Da Silva, 2005; Gow and Swinnen, 1998, 2001).

Participation in contract farming may have pro-poor effects, but the drivers of such participation need to be clarified, particularly in terms of partial participation. The second issue addressed is, therefore: **"What are the determinants of the choice of coordination modes including their combination?"**

Initial research carried out during the 1990s on the effects of contract farming highlighted negative impacts such as conflicts, power imbalances and rural inequalities between producers and their purchasers (Little and Watts, 1994). They also reported disguised proletarianization and self-exploitation (Clapp, 1988), greater exposure to risk (Wilson, 1986), corruption and unreliable sponsoring companies

[14] The conditions for producer participation.

(Eaton and Shepherd, 2001). Over the past 15 years, however, the results have been more optimistic. Several studies have found that contracts increase income (Girma and Gardebroek, 2015; Wang et al., 2014; Saenger et al., 2013; Bellemare, 2012; Rao and Qaim, 2011; Bolwig et al., 2009; Maertens and Swinnen, 2009; Minten et al., 2009; Miyata et al., 2009; Leung et al., 2008; Simmons et al., 2005; Warning and Key, 2002). Indeed, contracts provide producers with access to improved technology and technical assistance which increase their income through improved quality and yields (Dries and Swinnen, 2004; Gow et al., 2000).

Nevertheless, research is still necessary to question the impacts of contracts. First, most of the papers cited above concern export VCs of high-value products. In a literature review, Prowse (2013) finds that contract farming within domestic food chains cannot sustainably supply national markets. Swinnen et al. (2010) showed that contract farming is limited in the case of grain chains because the demand for high-quality products is limited, and the low perishability of grain eases side selling. Nevertheless, the literature starts documenting cases of contracts in domestic chains improving farmer income (Maertens and Vande Velde, 2017; Alemu et al., 2016). Second, the cases studied may be selected based on their capacity to improve farmer income since they yield results which are more easily publishable (Ton et al., 2016). Third, the relationship between contract participation and farmer income is not clear since some studies also find that contracts have no impact (Trifković, 2016) or even a negative impact on producer incomes (Mishra et al., 2016; Wanglin and Awudu, 2016). Fourth, participation in contract farming may have implication for farmer food security. It would appear that contracts decrease lean periods (Minten et al., 2009) and improve farmer food security through market effects for households with a larger number of children, especially girls (Bellemare and Novak, 2017). Nevertheless, there is little information regarding that link. Fifth, evaluation of the impact of contract farming does not consider the fact that farmers may be engaged in plural forms of marketing. For these reasons, the third issue addressed is: **"What are the impacts of contract farming in domestic grain chains on small-scale producer incomes and food security?"**

3. Theory: Institutional economics

I use the Global Value Chain (GVC) theoretical framework (Gereffi et al., 2005) which is linked to the Transaction Costs Economics (TCE) (Williamson, 1985). In chapter 3, I also use the plural forms (Ménard, 2013) and livelihoods (Scoones, 2009) frameworks.

Approaches to VCs have historically evolved with the paradigms of development and the schools of thought. The conception of *filière* was developed during colonial times by French institutions in order to organize the export of commodities such as cotton or coffee (Raikes et al., 2000). It considers that a VC

is a thread that links the succession of technical operations performed by different actors (Morvan, 1991). Porter (1985) then proposed a framework to analyze the competitive advantages of a firm on markets, considering their strategies of cost reduction or differenciation of products.

New Institutional Economics emerged during the 1990s. The theoretical schools of thought centered around this stream share the idea that institutions are endogenous to economics and that the analysis of economic change must take these institutions into consideration along with the reciprocal influences they have with individuals, organizations and the rest of society (Chavance, 2007). New institutional economics theories may nevertheless differ according to their doctrines (from liberalism to interventionism), their approaches (methodological individualism or holism), their closeness to standard economics and their degree of inclusion of other human sciences (Chavance, 2007).

The basic hypotheses which distinguish TCE from neoclassical economics[15] are the existence of transaction costs, bounded rationality, opportunistic behavior and the specificity of assets. TCE is based on the seminal work of Coase which highlighted the fact that the existence of the firm is explained by the costs of using the price coordination mechanism, called transaction costs (Coase, 1937). Williamson developed a theoretical framework explaining the links between transaction characteristics and the mode of governance which minimizes transaction costs (Williamson, 1983, 1983, 1994). The characteristics of transactions are asset specificity,[16] uncertainty[17] and frequency. Williamson identified a governance mode referred to as "hybrid" between market[18] and hierarchy.[19] Hybrid concerns time-consistent transactions between firms and refers to various types of contract (Williamson, 1991). When these three variables increase, the mode of governance which optimally reduces transaction costs tends towards integration (Williamson, 1998).

I use the GVC framework (Gereffi et al., 2005) which is rooted in the literature about "world systems" (Hopkins and Wallerstein, 1982) and Global Commodity Chains (Gereffi and Korzeniewicz, 1994) and has progressively integrated some elements of TCE. The world systems literature strives to understand "the unequal distribution of rewards among the various activities that constitute the single overarching division of labor defining and bounding the world economy" (Arrighi and Drangel 1986, p16). It is characterized by macro-holistic and long-term historical approaches that consider the socio-political

[15] Neoclassical economics considers that individuals have a substantive rationality, maximize their objective function based on their preferences and, in that way, contribute to the equilibrium of market (Chavance, 2007).
[16] The transferability of an asset used for a given transaction to another transaction (Williamson, 1985).
[17] A potential shock whose probability is unknown (Knight, 1921).
[18] Transactions in which the price is the only element of coordination.
[19] The body of operations is controlled by the same actor.

dimensions of the reproduction of a stratified and hierarchical system (Bair, 2005). It analyses the global commodity chain, "a network of labor and production processes whose end result is a finished commodity" (Hopkins and Wallerstein 1986, p159). A global commodity chain can be characterized by four dimensions: the input-output structure, the territory covered, the governance structure, and the institutional framework. Governance is defined by Gereffi and Korzeniewicz (1994, p97) as the "authority and power relationships that determine how financial, material, and human resources are allocated and flow within a chain." The framework enables us to analyze the influence that one actor in a driving position has on the distribution of tasks and skills along the chain. A global commodity chain may be either producer-driven (for instance in the case of capital-intensive products such as vehicles) or buyer-driven (for instance in the case of labor intensive products such as food goods).

Following the work of Gereffi and Korzeniewicz (1994), the global commodity chain approach took different directions according to disciplines (Palpacuer, 2015).[20] The economic approach explains the private governance of the chain and links it with the quality of the product, the technology and skills used and the distribution of value added between the actors. It was inspired by the strategic approach of Porter, which breaks firms down into different activities in order to identify those generating the most value added (Porter, 1980). A VC may be characterized by "different forms of coordination in various segments, yet a single and relatively coherent mode of overall governance" (Ponte and Gibbon, 2005, p3). Empirical works have identified that the hybrid form of TCE might be broken down into three forms of governance ranging between market and hierarchy (Sturgeon, 2002; Gereffi, 2001; Granovetter, 1985). They are determined by three variables which capture similar aspects of the industry and production process to the variables of TCE. The complexity of transactions refers to "information and knowledge transfer required to sustain a particular transaction, particularly with respect to product and process specifications" (Gereffi et al., 2005, p5). I understand that this variable includes some elements of uncertainty. The ability to codify transactions is the extent to which the information and knowledge about transactions can be communicated with explicit criteria and passed on to suppliers. A transaction which can be codified does not require specific investments. The third variable is perhaps that which differs most from TCE. The "capabilities of suppliers" concerns their capacity to satisfy the transaction requirements, which determines the terms of their participation.

Governance ranges between market and hierarchy. When transactions are complex, but the suppliers are able to meet different forms of demand, this is referred to as *modular governance*. *Relational*

[20] The sociologist approach is focused on the social embeddedness of inter-firm transactions. The political science approach considers that VCs are shaped by different actors according to their goals.

governance describes transactions, often informal, in which the actors are socially close, exchange information and may establish personalized relationships, thus reducing uncertainty but also creating a situation of interdependence. C*aptive governance* refers to the strong involvement of a leading firm in the operations of its suppliers.

The concept of upgrading analyzes the improvements of a firm, a VC or an economy, compared to its competitors, in order to reach more profitable markets (Gereffi, 1999). It is used to analyze several dimensions of the modernization (Kaplinsky and Morris, 2001). Process upgrading describes the technical change implemented by certain firms. It may generate the upgrading of a product, when there is an improvement of the quality. The upgrading may be functional, when the firm changes the organization of activities, with a tendency towards vertical integration[21] or outsourcing. Finally, upgrading may concern the chain, when it aims at supplying a different product on the end market, which can be brought about by upgrading the process, function and product. In this thesis, the term "modernization" describes the combination of a technical change[22] and the tendency of governance towards vertical coordination. The concept of upgrading is used to determine if producers get access to more remunerative markets thanks to the technical and organizational innovations implemented by the driver of the chain.

"Governance is about defining the terms of chain membership, incorporating/excluding other actors accordingly and allocating to them value-adding activities that lead agents do not wish to perform" (Ponte and Gibbon, 2005, p3). It is therefore a dynamic framework. Innovation tends to steer governance toward integration when it is combined with quality development by the lead firm, as it makes transactions more complex for suppliers, hence requiring more control. Integrated forms of coordination may particularly support producers when they face imperfections on the inputs and outputs markets (Grosh, 1994). Nevertheless, innovation may also push governance toward a more relaxed form when it strengthens the skills of suppliers (Gereffi et al., 2005). Innovation also erects barriers to entry, for instance through the improvement of quality, labelling and integration strategies. Such barriers to entry determine the distribution of rent between the actors. Producers who do not meet the criteria of inclusion may be marginalized (Maertens and Swinnen, 2009). The actor implementing the innovation obtains the largest share of the rent (Kaplinsky, 2000).

[21] Vertical integration is a synonym for hierarchy, when the body of operations is controlled by the same actor. The term "tendency of governance towards vertical integration" refers to the dynamic of governance, and includes other forms of vertical coordination, such as contract farming.
[22] The change in technology used for production or processing

Suppliers included may be upgraded, i.e. acquire new skills and access new markets through participation in a particular VC (Humphrey, 2004). The livelihoods[23] approach (Scoones, 2009) describes the characteristics of producers and their strategies of participation in various modes of governance within an uncertain context (Poole et al., 2007). This framework considers that farmers base their strategies on five types of capital. Farm capital is physical (road, technology, irrigation), human (gender, education, number of active members, etc.), social (links to leaders or to VC actors), natural (availability of water) and financial. The financial category includes household savings, in-farm and off-farm income (including remittances) and the ability to access other sources of funding.

I use a combined meso- and micro-approach in this thesis in order to ascertain how the changes in the organization of food VCs, in link with recent changes in policy and global markets, have economic and social implications for small-scale farmers. I particularly strive to understand the conditions of participation of producers in relation to the characteristics of the transactions and the power relationships among the VC actors. I therefore do not call upon literature on world systems, which has a macro- and holistic approach (Raikes et al., 2000), although it can explain long-term historical changes. I also do not root the research in the convention and regulation theories. Those theories may provide similar analyses of the mode of coordination with the GVC theory and shed light on the influence of policies. Nevertheless, they do not have explanatory variables at the scale of transactions (Ponte and Gibbon, 2005). The global commodity chain approach has a focus at the meso-level and includes the power dimension. Furthermore, compared to the GVC theory, its strength is to be embedded in socio-institutional and geographical contexts which shed light on drivers external to transactions, such as policies (Bair, 2005). It also takes into consideration the functional approach of *filière*. Nevertheless, the global commodity chain approach hypothesizes that there is always a driver which is either upstream or downstream (Raikes et al., 2000). It does not leave room for co-driving by several actors in the VC (Moustier, 2009) and does not make it possible to distinguish the coordination modes according to the intensity of the driving from the same segment. Furthermore, it does not provide variables explaining the changes in driving and governance. Finally, it was elaborated with the analysis of manufactured goods in mind and must be adapted to agricultural goods for which regulations are different.

I use the GVC framework which is a theory explaining the changes in governance by three key variables representing the characteristics of the industry. It proposes five types of governance which make it possible to distinguish the coordination mechanisms according to the magnitude of driving. The concept

[23] "A livelihood comprises people, their capabilities and their means of living, including food, income and assets" (Chambers and Conway, 1992, p1).

of upgrading explains the participation of firms in the VCs which leave room for analysis of the effects at the micro-level. As is true in TCE, the GVC theory is adapted to explain changes in the organization of domestic food chains in Asia and Africa. It provides a framework to analyze imperfect markets through transaction costs. Taking the institutional environment into consideration serves to explain the influence of various sources of uncertainty such as insecurity, climate, prices and transportation. The GVC framework focuses on the governance dimension of global commodity chains and is not oriented towards the embeddedness of VCs. Nevertheless, it acknowledges that "history, institutions, geographic and social contexts . . . matter" (Gereffi et al., 2005, p82). For this reason, it also makes it possible to take the influences of policies on market organization into consideration.

Compared to TCE, the strength of the GVC framework is to distinguish and explain the diversity of forms of coordination which are termed hybrid by TCE. It therefore makes it possible to compare tied credit-output linkages with various forms of contracts or other institutional arrangements. Furthermore, the driving notion enables us to describe situations of power inequality between VC actors and provides a new perspective for policies. The GVC framework also focuses more on the question of supplier skills and remuneration in relation to innovation in terms of quality, whereas TCE has a perspective based more on property rights (Moustier, 2009).

The GVC framework was built on observations of global markets where VCs are divided among multinational firms, geographic spaces and heterogeneous institutional environments. This framework may be adapted to analyze food chains at a domestic level (Moustier, 2009). Indeed, relationships among VC actors at the domestic level may also be characterized by an imbalance of power and authority. The three explanatory variables of the framework may also describe the structure of the industries and production processes which influence the form of governance at the level of one country. More particularly, the question of small-scale farmer inclusion in modernizing VCs may be linked to their skills and livelihoods. Furthermore, within the same country, there can be variations between distinct geographical areas in terms of institutional environment, wealth and technology.

TCE and GVC predict the convergence of governance modes for transactions with similar characteristics which are implemented in the same institutional environment. These theories nevertheless fail to explain the existence of plural forms, "those organizational arrangements in which, for a class of transactions dealing with the same activity and within the same institutional and competitive environment, a party uses simultaneously different modes of governance or relies simultaneously on substantially different types of contracts" (Ménard, 2013, p125). The theory of plural forms is recent, and also rooted in TCE. Most cases studied to understand the drivers of plural forms relate to franchise

agreements (see Bigio Schnaider, 2016 for a literature review) and point out the role of uncertainty in the non-convergence of institutional arrangements. They find that plural forms of governance appear when a degree of market, technology and/or performance uncertainty is combined with a minimum level of asset specificity (Bigio Schnaider, 2016; Ménard et al., 2014). More specifically, the complexity of transaction refers to the difficulty in evaluating the costs of governance modes and may be generated by uncertainty, in particular with regard to technology (Ménard, 2013). This theory is still in its early days and requires more extensive empirical and theoretical development.

4. Research questions and hypotheses

The modernization of food chains in Asia is understood as a process of technical change and the tendency of governance towards vertical integration. The general research question of this thesis deals with the effects of technical change and vertical coordination on farmers in Africa. It may be broken down into three specific research questions.

1. The first research question compares the modernization processes of domestic food chains in Asia and Africa. I explore whether the governance of domestic food chains is driven by the midstream segment and tends towards vertical integration. The hypothesis is that such a process may be observed (Reardon et al., 2013).
2. The second research question addresses the inclusion of small-scale farmers in contract farming. I examine the influences of uncertainty and livelihoods on the plurality of governance. The hypothesis is that plural forms can be explained by the financing dimension of producer livelihoods and their strategies to reduce uncertainty (Mujawamariya et al., 2013; Masuka, 2012).
3. The third research question addresses the impact of vertical coordination on farmer incomes and food security. The hypothesis is that contract farming increases farmer incomes through access to credit, improved inputs and extension services (Swinnen, 2007), and that it improves food security through this effect on incomes (Bellemare and Novak, 2017).

5. Case study: The domestic rice value chain in Senegal

Using a VC approach requires definition of the boundaries and components of the VC. The case studied in this thesis is the rice VC in the Senegal River Valley (SRV). This VC includes Senegalese and foreign actors fulfilling the functions of agro-supply, production, husking, trade and distribution of rice. It also includes the support services, such as transportation and financing. It is a domestic VC, which means that all the actors are located in Senegal and carry out the operations concerning paddy produced in

Senegal. I therefore consider that the global rice VC is part of the context, and I do not make it the focus of the research. Nevertheless, since importers are involved through government intervention in trading the rice produced in Senegal, they are considered as part of the domestic VC. I also do not focus on how the agro-suppliers get the inputs they sell to producers. I focus on the whole VC from agro-supplying to retailing but I particularly analyse the functions of production and husking which take place in Dagana Department, in the SRV. I also consider the institutional environment in which the domestic rice VC operates, which includes policies from the government and international organizations, changes in consumption patterns and international markets.

The domestic rice VC in Senegal was selected for the case study because it seemed to present similar patterns of modernization to those observed in Asia. Changes in international prices, policies and demand have increased the likelihood of observing the modernization of this VC. Apparent criteria of modernization were identified by literature reading (Demont et al., 2013; Baris and Gergely, 2012; Demont and Rizzotto, 2012; Gergely and Baris, 2009; MA, 2009; Fall, 2006; David-Benz et al., 2005; Bélières and Touré, 1999). That literature highlighted investments in new processing techniques and new forms of coordination including contracts, but did not document them precisely.

Analysis of transformations in the domestic rice VC in Senegal may shed light on bigger changes at the scale of West Africa, where similar factors favorable to the modernization of domestic food chains are observed. First, as in other West African countries, rice consumption is increasing in Senegal. Rice consumption in West Africa grew by 5.1% per year between 1961 and 2009 (Lançon and Mendez del Villar, 2013), and the trend is similar in Senegal with an increase of 3% per year since the 1990s (GRISP, 2013). The average rice consumption in Senegal was 95kg per capita and per year between 2000 and 2012, which is one of the highest in the region (Fofana et al., 2014). There in an increasing demand for quality rice[24] in West Africa (Demont and Ndour, 2015), notably in Senegal (Demont et al., 2013). The particularity of Senegal is that 98% of the rice consumed is broken rice (Hathie and Ndiaye, 2015), i.e. a byproduct of milling. Nevertheless, the change in demand towards a higher-quality product also concerns broken rice (Demont et al., 2013). Second, the dependency on imports is strong in Senegal as in many countries in West Africa. The region has to import 45% of its rice to get the 11.2 million tons consumed per year on average between 2000 and 2010 (Lançon and Mendez del Villar, 2013). The significance of imports is even stronger in Senegal, where imports increased by 2.2% per year between

[24] "Intrinsic quality attributes include color, cleanliness, purity, grain shape and size, grain homogeneity, proportion of head rice, aroma, taste, swelling capacity, etc., while extrinsic quality include packaging, labeling, branding, reputation and information" (Demont and Ndour, 2015, p72).

1960 and 2011 (Demont et al., 2013) to reach on average 80% of rice consumption between 2001 and 2010 (Seck et al., 2013). Therefore, "among staple food crops, rice represents Africa's best opportunity for the reduction of imports" (CARD, 2009, p3). Senegal, as several others in the region, has easy access to imports because of its coastal position. Its strong dependency also increases its vulnerability to price shocks on global markets. Third, rice VCs are targeted by current West African policies. Senegal is also concerned by policies favoring the modernization of domestic rice VCs, because it is a member of Economic Community of West African States and the Coalition for African Rice Development. Moreover, the Senegalese government has been implementing a national program for self-sufficiency since 2009 (MA, 2009).

Around the world, family farming contributes 94% of rice produced (Bélières et al., 2015). Rice is a particularly significant source of food and income for the hundreds of thousands of family farmers growing it in Senegal and other West African countries (Seck et al., 2013). It is noteworthy that Senegal is one of the poorest countries in the world, with 38% of the total population living on less than $1.9 a day in 2012 (World Bank).[25] Agriculture generates 15.8% of total domestic product growth and employs 43.8% of the total active male population. Nevertheless, literature about the modernization of grain chains and its effects on poverty is less extensive than literature about horticultural products. Indeed, high-value and commodity export products are more likely to generate income for small-scale producers (Reardon et al., 2009; Swinnen and Maertens, 2007) than staples (Swinnen et al., 2010). But, more research should be carried out about staple food crops because it has been recently demonstrated that transformations in such VCs can benefit small-scale farmers, as observed in Benin (Maertens and Vande Velde, 2017).

Dagana Department in the SRV was selected as the study area because it was the only location where technical changes among millers and new organizational devices were observed in 2014. The SRV is the core area of rice production in Senegal. It provided 80% of domestic production in 2014 (USDA, 2015). Some 45,000 family farmers are involved in rice production in the SRV (Gergely and Baris, 2009). At the scale of the region of Saint Louis which includes Dagana Department, 39.5% of households were poor in 2010 (ANSD, 2010). And 16.1% of households in Dagana Department were affected by food insecurity (WFP, 2014). More information about the rice VC and the study area is given based on the requirements of the research questions addressed in each chapter.

[25] Data are available at http://data.worldbank.org/

Rice is a politically strategic product in West Africa because it is a major contribution to national food security. Since independence, government strategies aim at supplying rice at low prices to the population. Certain researchers consider that there was an "urban bias" during the three last decades. Indeed, little support was given to agricultural production, and the strategy was to import cheap rice for urban consumers, who make up the main part of voters (Bezemer and Headey, 2008). Policies implemented after the price crisis also purport to supplying low-cost rice, but now through modernization of the domestic rice chain.

6. Methods

The thesis addresses one broad question broken down into three questions which vary in their historical reach, geographic scale, conceptual framework, object of analysis and variables of interest. Quantitative and qualitative methods are used. The main components of the approach are presented here and developed in each chapter with regard to the specific question addressed.

The relevant literature was consulted through conventional scientific databases[26] and those managed by international[27] and national[28] development organizations. Two theses provided historical and contextual inputs (Fall, 2006; Bélières and Touré, 1999).

A qualitative approach was adopted to address historical changes in policies, chain organization and actor strategies. It also served to prepare each quantitative data collection process. Between 2014 and 2016, I conducted a total of 154 semi-directed qualitative interviews with VC actors, researchers, development agents and policymakers. A snow-ball sampling method was used. Survey reports were systematically written. The topics discussed are presented in the relevant chapters.

I conducted a cross-sectional survey to represent a dynamic phenomenon through the static comparison of different ideal types.[29] Sampling methods and variables of interest are described in each chapter. In total, databases concern 90 producer organizations, 607 small-scale producers, 49 processing units and 60 traders. The database relating to small-scale producers was used in each chapter. Data collection was

[26] Such as Agritrop, Cairns, Cambridge Journals, EBSCO, Econlit, Erudit, Global Value Chain website, Inter réseau, Jstor, Maney Publishing, oxfordjournals, Persee, ProdInra, Proquest, RePEc, Sciencedirect, Scopus, Springer Journal, Sudoc, Taylor & Francis, Thémaclic, Ulrichsweb, Web of Knowledge, Wiley Online Library, WorldSciNet Journals.

[27] Such as the World Bank, the Food and Agricultural Organization (FAO), the Agence Française de Développement (AFD), the United States Department of Agriculture (USDA).

[28] Such as in Sénégal, the Société d'Aménagement et d'Exploitation du Delta (SAED), the Agence de Régulation des Marchés (ARM), the Agence Nationale de Statistique et de la Démographie (ANSD).

[29] A longitudinal study was not used because of the time constraint of the thesis.

carried out between March and June 2015, covering the 2014 rice-growing seasons. I also used data from François et al. (2014), who carried out a survey of 254 traders in order to assess net margins along the downstream segment of the same VC in 2014.

Quantitative data were analyzed with econometric models, using the software Stata® (version 13). The participation of contracted producers is analyzed using a multinomial logit model and the impact analysis of contract farming on farmer income and food security is carried out by means of quasi-experimental methods. Impact evaluation methods enable to correct selection bias a posteriori (Khandker et al., 2009). It corrects differences between the control and treated groups in order to ensure that changes in performance (income and food security) are only due to the variable of interest (contract participation).

Focus group discussions were organized in order to identify certain impact pathways and contribute to the policy debate. Five focus group discussions held in March 2016 each brought together between 7 and 25 participants. They were organized at farmer and national development agency levels.[30]

7. Thesis outline

Each chapter corresponds to one paper, an except for the introduction and a conclusion. Table 1 presents the chapters at a glance.

Chapter 2 analyzes the organization of the rice VC in Senegal to ascertain if it follows the same trend as the Asian quiet revolution. It calls upon the GVC theoretical framework. A total of 154 qualitative interviews were carried out as well as surveys with 913 stakeholders at each level of the VC. The finding is that the Senegalese modernization is in step with the one taking place in Asia. Nevertheless, in Senegal, (1) the benchmark situation between producers and village traders is a spot transaction with relational tendency[31] (and not a tied credit-output transaction), and processors collecting paddy before the modernization, (2) credit policies contribute to the change in governance and (3) the modernization of the rice VC does not make it competitive relative to the chain of broken rice imports. I recommend the inclusion of small-scale processors in the modernization through improved access to credit and processing techniques, and I recommend carrying out feasibility studies about the use of small-scale mechanisation.

[30] The outcomes are presented at http://afrique-ouest.cirad.fr/actualites/2016/impact-de-la-contractualisation-sur-les-revenus-et-la-securite-alimentaire-des-petits-producteurs-de-riz-presentation-des-premiers-resultats/(language)/fre-FR

[31] We use the term of "spot transaction" to describe a transaction in which the price is the main determinant, but which may also include relational proximity between the seller and the purchaser.

Chapter 3 examines the participation of small-scale producers in contract farming, with a specific interest in the combination of marketing modes. I use a conceptual framework which analyzes the influences of livelihoods and uncertainty on the plurality of governance. A multimodal logit model with 372 observations explains the participation of producers in governance modes combining contracts and spot transactions. Imperfections on credit and paddy markets encouraged the state and private millers to introduce marketing and production contracts. I find that producers participate in plural forms to secure agricultural financing. The segmentation of the credit market is linked to the indebtedness of producers to the national agricultural bank. Uncertainty is a second order driver towards plural forms.

Chapter 4 assesses the impacts of marketing and production contracts on farmer incomes and food security. I apply, using a dataset of 594 observations, instrumental variables and propensity score matching models to correct selection bias. I find that as a financial device, marketing contracts have no impact on agricultural practices, yields, product quality and income but slightly improve food security by mitigating price seasonality. Production contracts have a positive impact on the income of producers who were excluded from bank credit but include implicit interest and insurance costs, meaning that these producers make less profit than those financed by the bank. Policies should fund research to understand the drivers of loan default by producers to design an appropriate insurance system for agricultural credit. Furthermore, the price of production contracts should be negotiated within the interprofessional organization.

There is another chapter in French[32] in the appendix 3, which documents the effects of investments from agribusinesses on the participation of small-scale producers in the management of agricultural resources, and on land access, agricultural practices, food security and income of small-scale producers. It calls upon the GVC and territorial governance theoretical frameworks. Some 118 rice plots were monitored during the 2016 dry season, 332 producers linked with three agribusinesses recently set up in the SRV were interviewed and a participatory workshop with representatives from both categories was organized. The case studies show that the effects of large-scale investments on the participation of small-scale producers in the management of agricultural resources depend on the consideration of customary and legal institutions. Furthermore, investments have different effects according to the types of producers. The access to land and water is improved for growers and reduced for agropastoralists. Finally, the hierarchical control of rice production brings about an increase in cultural intensity.

[32] I decided to write it in French because it proposes an overview of the findings of the Valchain project and of the thesis, and can be disseminated to policymakers and other VC stakeholders in Senegal.

Chapter 5 presents the global conclusion of the thesis. I present the main findings, the policy recommendations, the main limitations of my work and directions for future research.

Table 1: Thesis at a glance:

Chapter	Issue	Conceptual framework	Data	Data analysis method	Main results
2	To what extent can the quiet revolution be documented in Africa?	Global Value Chain	154 semi-directed interviews Quantitative surveys with 913 actor in the value chain	Historical and qualitative analysis Descriptive statistics	• As in selected Asian countries, the rice value chain in Senegal is undergoing technical change and a tendency of governance towards vertical integration. • The benchmark situation is a spot transaction with the processors collecting paddy before the modernization. • Credit policies contribute to the change in governance • The modernization of the rice value chain does not make it competitive relative to broken rice imports.
3	What are the determinants of the choice of coordination modes, including their combination?	Global Value Chain Plural forms Livelihoods	Cross-sectional quantitative surveys with 372 producers	Multimodal logit model	• Producers participate in plural forms to secure agricultural financing. • The segmentation of the credit market is linked to the indebtedness of producers to the national agricultural bank • Uncertainty is a second-order driver towards plural forms.
4	What are the impacts of contract farming in domestic food chains on small-scale producer incomes and food security?	Global Value Chain (implicit)	Cross-sectional quantitative surveys with 594 producers	Impact evaluation: Instrumental variable and propensity score matching models	• The marketing contract is a financial device which has no impact on agricultural practices, yields, product quality and income. • The marketing contract slightly improves food security by mitigating price seasonality. • The production contract has a positive impact on the income of producers who were excluded from bank credit but includes implicit interest and insurance costs, meaning that these producers make less profit than those financed by the bank.
Appendix 3	What are the effects of investments from agribusinesses on (1) the participation of small-scale producers in the management of agricultural resources; (2) land access, agricultural practices, food security and income of small-scale producers?	Global Value Chain Territorial governance	Monitoring of 118 rice plots, quantitative surveys with 332 producers One participatory workshop	Mixed method: semi-structured interviews Descriptive statistics	• Participation of small-scale producers in the management of agricultural resources depends on the consideration of customary and legal institutions. • Investments have different effects according to the types of producers. • Access to land and water is improved for growers and reduced for agropastoralists • The hierarchical control of rice production brings about an increase in cultural intensity.

CHAPTER 2: THE ONGOING MODERNISATION OF THE RICE VALUE CHAIN IN SENEGAL: A MOVE TOWARD THE ASIAN QUIET REVOLUTION?

First version presented at the 9th seminar of research in social sciences organized by the Société Française d'Economie Rurale (SFER), December 10-11, 2015, Nancy, France):

Soullier, G. and Moustier, P. (2015) 'Does modernization of the rice value chains in Senegal illustrate a move toward the asian quiet revolution?', *9th seminar of research in social sciences, December 10-11, 2015*, Nancy (Université de Lorraine) [Online]. Available at https://afrique-ouest.cirad.fr/content/download/6641/61901/version/1/file/obj_5614_file_Soullier-et-Moustier.pdf and http://ageconsearch.umn.edu/record/245704 [Accessed 23 August 2017].

Revised version presented at the 149th Seminar of the European Association of Agricultural Economists:

Soullier, Guillaume, and Paule Moustier. "The ongoing modernisation of the rice value chain in Senegal: a move toward the Asian quiet revolution?" 149th Seminar, October 27-28, 2016. Poster communication. Rennes, France: European Association of Agricultural Economists, 2016. See poster 1 in appendix.

The revised version is under review at Development Policy Review.

1. Introduction

Agricultural growth plays a major role in poverty reduction and economic development but the pathways for agricultural growth are still the subject of debate (World Bank, 2008). Research work conducted on the modernisation of agricultural chains highlights some positive impacts of the development of standards and vertical coordination on rural livelihoods (see, for example, Maertens and Swinnen, 2009; Minten et al., 2009). However, such work has been documented mainly for global value chains (GVC).

In a context of growing urbanization and following the world food price crisis, domestic food chains deserve greater attention. In India, Bangladesh and the People's Republic of China, research conducted by Reardon et al. (2012) revealed that the modernisation of domestic rice and potato value chains (VCs) was enhanced by policies and fuelled by processing and trading stakeholders that invested in modern rice milling machines and cold storage facilities. The authors argue that this transformation has been beneficial to the local economy.

In Africa, some research documents the dominance of traditional VCs in which numerous market stakeholders handle limited volumes of products in a competitive way and are able to cope with the high instability of supply and demand (Fafchamps, 2004). However, since the first world food price crisis, governments in Africa are aiming at modernising domestic VCs to reach self-sufficiency (Fofana et al., 2014). Certain VCs seem to be transforming (Reardon et al., 2013).

The history and present situation of the rice VC in Senegal seem to provide a good case reflecting what has been observed in Asia. The purpose of this paper is to review the dynamics and organisation of this VC, in order to see if it is following the same trends as those described by Reardon et al. (2012). We complete the paradigm of Structure-Conduct-Performance with the GVC analysis framework (Gereffi et al., 2005) because it highlights a very important aspect of the quiet revolution, which is the influence that one stakeholder in a steering position can have on the distribution of tasks, skills and value added. The quiet revolution includes sufficient information to understand it within a governance framework. The performance of the chain is understood in terms of competitiveness, particularly with regard to product quality, quantity supplied, costs of production, stakeholder margins and final prices.

In what follows, we go into more detail on the modernisation described in Asia (section 2). Then we outline the conceptual framework (section 3) and methodology (section 4). We analyse the historical change in governance (section 5), the present modernisation of the VC (section 6) and the distribution of costs and margins along the chain (section 7). We then endeavour to determine if a quiet revolution

is underway in Senegal by comparing it with the Asian transformations (section 8). Finally, we summarise our findings and present policy implications (section 9).

2. Documented changes in food chain governance in Asia and Africa

2.1. The quiet revolution in Asia

The 'supermarket revolution' brought to the fore a change in the organisation of food chains as the result of increased power from the downstream segment (Reardon et al., 2003). On the contrary, the quiet revolution (Reardon et al., 2012) shows a change in organisation driven by the midstream segment.

The authors documenting the quiet revolution selected three countries to represent the Asian continent: India, Bangladesh and the People's Republic of China. The issues addressed are the transformation of the organisation of the rice and potato chains, the changes in conduct of actors and the inclusion of small-scale stakeholders. The benchmark situation of the quiet revolution is a traditional VC comprised of many intermediaries, using weakly capitalised technologies and yielding expensive, low-quality products. Producers buy few inputs, are poorly integrated into markets and are engaged in 'exploitative relationships of tied credit-output linkages where traders lend to farmers and thus underpay and exploit them' (Reardon et al., 2012, based on Lele, 1971).

Public policies were important in enabling the transformations (Reardon et al., 2012). There were investments in infrastructure such as irrigation canals, roads, power grids and mobile phone communication networks. Research and extension policies were also favourable to the modernisation. Few policies subsidized investments in processing techniques and improved inputs, although they were not common. Furthermore, financial capital from the agricultural and industrial sectors was available for investment, and the increase in average household incomes drove the demand for products of higher quality. Finally, the green revolution had enabled producers to intensify their practices and to increase yields and the share of produce sold (Reardon et al., 2012).

The modernisation is characterized by investments in new techniques and integration of the collection function. First, there was an expansion of the volumes of activity, followed by investments in new techniques in the midstream segment and the concentration thereof (Reardon et al., 2012). This change in techniques increased the capacity of husking (up to three tons per hour) and storage (from 180 to 3,000 tons from the 1990s to 2010) (Reardon and Minten, 2011). The number of large rice millers increased, that of small rice millers decreased (Reardon et al., 2014). Second, the tied credit-output market relationships with traditional collectors disappeared to give way to vertical coordination.

Midstream stakeholders integrated collection and sometimes set up contractual transactions with wholesalers (Reardon et al., 2012). Downstream, the changes tend to move toward the supermarket revolution. Mills add value to quality rice varieties through packaging, branding and traceability (Minten et al., 2010). The quality of rice is defined by the size and shape of the grain, and other attributes such as the degree of whiteness, aroma, cleanliness (degree of foreign matter), amount of broken rice and age of the grains.

The final retail price increases with the quality of rice, for instance by 69.2% with the production of fine rice in Bengladesh (Minten, Murshid, et al., 2013). The share in the final amount of the profit margin generated by all stakeholders along the chain also increased, while costs decreased. The change to quality rice is advantageous for millers and retailers, who for instance get respectively 44% and 49% of the quality premium for fine rice in Bangladesh (Minten, Murshid, et al., 2013). Producers may get a slightly higher income in absolute terms. For instance, 'rice farmers in Noagoan received $198/ton for common and $218/ton for fine rice' (Reardon et al., 2012: 144). Nevertheless, Minten et al. (2013) conclude that producers do not benefit directly from higher retail prices.

Modernisation is most advanced in the People's Republic of China, where the modern VC dominates. In India, the modern VC is quickly expanding, although there are still collectors. Modernisation is less advanced in Bangladesh, where the traditional VC dominates, although transformation is emerging (Reardon et al., 2012).

2.2. Limited evidence for Africa

We selected an African country because there are policies on that continent which aim at modernising domestic food chains since the world food price crisis (Fofana et al., 2014) and specific VCs seem to be modernising (Reardon et al., 2013).

The supermarket revolution is not ongoing in many countries in Africa (Tschirley et al., 2010), with a few exceptions such as Kenya (Neven and Reardon, 2004). There has been a dominance of traditional food chains since the 1990s (Fafchamps, 2004). The environment is uncertain because of various constraints: low investment in road infrastructure, unstable production due to climate conditions and unstable demand due to low purchasing power (Fafchamps, 2004). Farmers and traders are limited in capital; they carry out transactions based on trust. Interactions are frequent and the choice of partners is made based on social linkage and reputation, which enables the sharing of risks among economic partners (Moustier, 2012).

But the recent evolutions in the institutional environment might be favourable to a revolution in domestic food chains. Price shocks on the global market affected the food security and income of the poorest households (Badolo and Traoré, 2015; Boccanfuso and Savard, 2011; Cudjoe et al., 2010). Several African governments set up policies aimed at modernising domestic VCs (MA, 2009; CARD, 2008).

Specific VCs in Africa seem to be modernising (Reardon et al., 2013). In Ethiopia, the increasing adoption of improved inputs and the rise in demand for high-quality produce were observed in the teff VC (Minten, Tamru, et al., 2013). In Tanzania, the food system supplies a wide variety of locally-processed, high-quality products which are competitive with imports (Ijumba et al., 2015).

We propose an in-depth analysis of the rice VC in Senegal where we will document modernisation characteristics that approximate those of the quiet revolution.

3. Conceptual framework

The quiet revolution framework is mostly empirical with some loose reference to the Structure-Conduct-Performance paradigm grounded on Bain (1959). This paradigm links the structure of markets (degree of concentration and differentiation of firms) to the performance of the sector (reduction of costs and generation of added value). It also analyses the distinct functions performed by the chain stakeholders, the techniques they use and their modernness in terms of scale and number of intermediaries.

We complete this paradigm with the GVC theory (Gereffi et al., 2005). This framework analyses important dimensions of the supermarket and quiet revolutions (Reardon et al., 2003, 2014), i.e. the influence that the institutional framework and the actor in a steering position have on the distribution of tasks and skills along the chain. It particularly focuses on links between changes in quality of product and the distribution of costs and benefits between VC members.

The GVC framework analyses the Global Commodity Chains, 'a network of labour and production processes whose end result is a finished commodity' (Hopkins and Wallerstein, 1986, p159). It takes into account the network theory, the literature on firm capabilities and learning and TCE (Bair, 2009). A Global Commodity Chain can be characterised by four dimensions: the input-output structure, the territory covered, the governance and the institutional framework.

The institutional dimension includes policies which can directly and indirectly influence the dynamic of governance. Direct interventions in the VC may be implemented by state agencies taking part in the

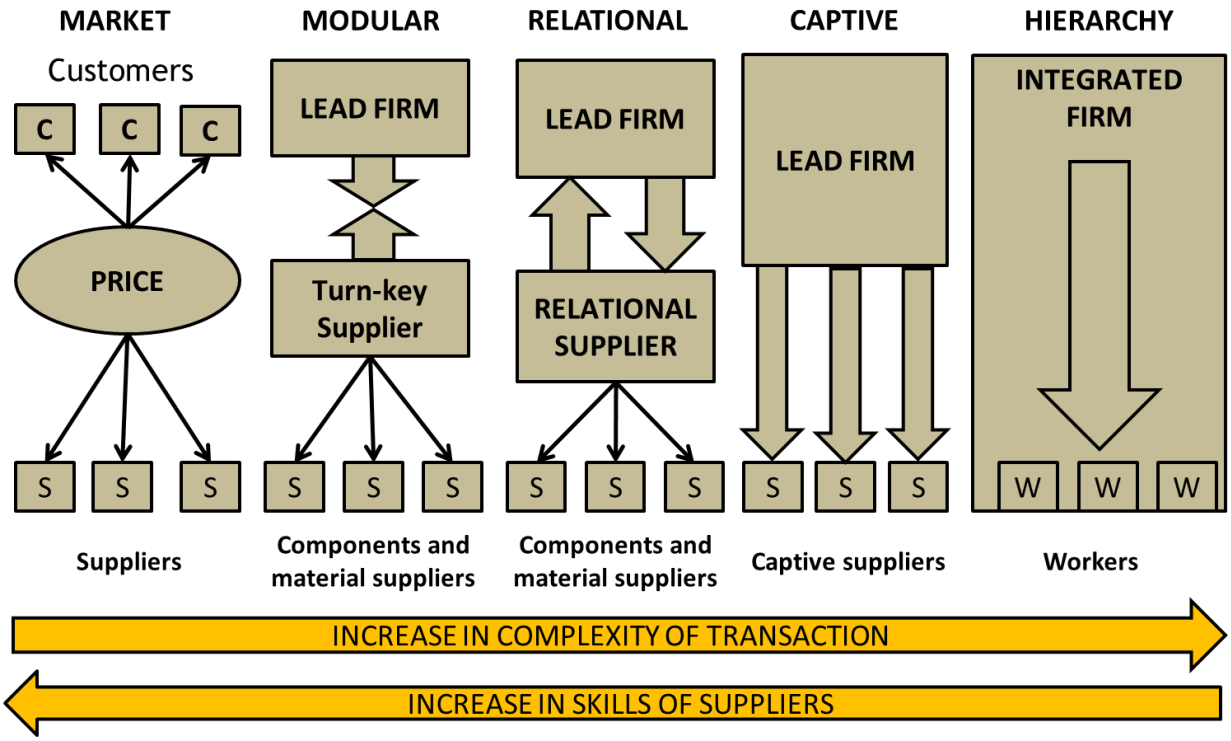
transactions or defining new coordination mechanisms. Indirect interventions may constrain (norms and taxes) and support the actors of the VC (subsidies, technical support).

Governance is defined as the 'authority and power relationships that determine how financial, material, and human resources are allocated and flow within a chain' (Gereffi and Korzeniewicz, 1994, p97). Three variables, representing the characteristics of the industry and production process, explain the dynamics of VCs: the complexity of transactions, the ability to codify these transactions and the capabilities of the supply base. They determine five types of governance. *Governance by the market* concerns simple transactions in which price is the only element of co-ordination. When transactions are complex, but the suppliers can meet different forms of demand, this is referred to as *modular governance*. *Relational governance* describes transactions, often informal, in which the stakeholders are socially close, exchange information and may put in place personalised relationships, thus reducing uncertainty but also creating a situation of interdependence. C*aptive governance* refers to the strong involvement of a leading firm in the operations of its suppliers. Finally, in *hierarchy governance*, the body of operations is controlled by the same stakeholder.

Technical change consists in the use of new production techniques, at the scale of millers or farmers. Producers may strengthen their skills with the implementation of new agricultural practices including improved varieties or chemical inputs. The quiet revolution is characterized by a technical change of the midstream segment. In Senegal, the traditional VC uses small-scale processing units that husk less than one ton of paddy per hour (Fall, 2006). Technical change is the process of moving to semi-industrial (husking between one and two ton per hour) or industrial (husking up to three tons per hour) techniques performing functions such as drying, cleaning and grading.

In the GVC framework, technical change tends to steer governance toward integration when it is combined with quality development, as it makes transactions more complex, hence requiring more control. Technical change may also lead to governance taking a more relaxed form, when it strengthens the skills of suppliers (Gereffi et al., 2005). Technical and institutional change erects barriers to entry, for instance through the improvement of quality, labelling, and strategies of integration (Kaplinsky, 2000). These barriers to entry determine the distribution of costs and margins among the stakeholders. Those setting up the innovation obtain the greatest share. Figure 1 shows the influences that technical change has on governance.

Figure 1: Influences of technical change on governance



Source: Adapted from Gereffi et al. (2005)

Therefore, the conceptual framework analyses the influences of the institutional environment and technical change on governance. It also analyses the changes implied in competitiveness of chains in terms of quality of product, quantity supplied, costs of production, stakeholder margins and final prices.

4. Methodology

We selected the rice VC in Senegal since it seemed to provide a good case reflecting the quiet revolution, with increasing investment in modern techniques and new co-ordination modes between producers and processors (Demont et al., 2013; Baris and Gergely, 2012; Demont and Rizzotto, 2012; Gergely and Baris, 2009; MA, 2009).

We conducted 154 in-depth interviews. We focused on stakeholders in the upstream VCs located in Dagana Department, since technical and co-ordination changes mainly occur at their level. We carried out 47 interviews with producers, 38 with small-scale and industrial rice millers. We also carried out interviews with 23 traders operating in Dagana and Dakar, including wholesalers and importers, and 46 interviews with agents of public and private research and development organisations. Topics discussed were policies, stakeholder behaviour, quality management and changes in co-ordination.

We also used quantitative questionnaires to assess the distribution of margins and costs along the chain in 2014. Databases include 550 rice growers randomly selected after stratification according to their marketing strategies,[33] 49 processing units, and 60 traders, randomly selected. We also used data from François et al. (2014), who carried out a survey of 254 traders in order to assess net margins along the downstream segment of the same VC in 2014. Retailers from Dakar and other major cities were randomly selected after stratification per quarter. They were surveyed on their costs and returns and asked to indicate their suppliers, who, in turn, were surveyed.

5. Institutional and technical changes in the rice value chain

Historically, public policies and global markets have either hindered or fostered modernisation of the rice VC (Fall, 2006; Bélières and Touré, 1999).

5.1. Hierarchy governance driven by the state (1964–87)

The expansion of irrigated rice growing started in the Senegal River Valley (SRV) at independence, in 1964 (Le Gal, 1995). State intervention supported the development of the VC: Each segment was directly or indirectly managed through two state agencies, SAED (Société Nationale d'Aménagement et d'Exploitation du Delta) and CPSP (Caisse de Péréquation et de Stabilisation des Prix). SAED set up the hydro-agricultural infrastructure at a rate of 600 ha per year from 1965 to 1980 (Bélières and Touré, 1999). SAED also provided producers with technical advice and subsidised inputs. The intensification of rice cropping started in 1973 (Le Gal, 1995), with land preparation, the use of high-yield and non-mixed varieties, mineral fertilisers, chemical weeding and mechanised harvesters. Farmers marketed their paddy to two rice mills managed by SAED, which bought it at a fixed price regardless of moisture and impurity content (Fall, 2006). CPSP was in charge of rice distribution. It highly taxed imports in order to subsidise the purchase of domestic paddy. This formal VC became deficit-ridden and collapsed (Fall, 2006) because the rice was sold at prices under processing and purchasing costs, and taxes on imports were not sufficient to cover the deficit.

In parallel to that formal VC, a traditional, informal one appeared (Bélières and Touré, 1999). Small-scale traders, called *banabanas*, used mills which only provided the function of husking and supplied unsorted rice with impurities (Fall, 2006). Producers used that VC to obtain a quick cash return, while it took several months with SAED. Some of them also used this VC to sell their produce without paying off their loans.

[33] The database contains 265 producers involved in spot transactions, 155 producers involved in production contracts, and 130 producers involved in marketing contracts.

Since co-ordination between stakeholders was planned, the governance of the rice VC during this period was integrated, and the chain was driven by public bodies. The emerging informal VC had market governance with relational tendency.

5.2. Liberalisation and market governance (1987–2007)

5.2.1. State intervention reduced, national economy opened up to global markets

First, production factor markets were opened to competition in 1987 (land, credit, seed and pesticides). Land development was turned over to the private sector. Irrigated land increased from 23,000 ha to 40,000 ha in 1991 (Bélières and Touré, 1999). Investments were made in hydro-agricultural equipment of low quality in terms of drainage and solidity of bunds, resulting in low output. SAED continued its activity of production support. A national bank called *Caisse Nationale de Crédit Agricole du Sénégal* (CNCAS) was created (Fall, 2006). It proposed various loan formats for production, investment and marketing. In the case of production credit, the bank paid agri-suppliers who provided inputs to producer organisations, who repaid the bank once the paddy was sold. Credits grew from FCFA 150 million[34] in 1987 to 5 billion in 1993 (Bélières and Touré, 1999) but the bank followed a financial recovery plan due to low reimbursement rates (Fall, 2006). CNCAS hardened its selection criteria. Other financial institutions got involved in the SRV, but they faced the same problem.

5.2.2. Development of the traditional value chain

Second, in 1994, the downstream part of the VC was privatised, prices deregulated and the currency (CFA[35] franc) was devalued. Rice millers owned by SAED were privatised and the private sector was encouraged to invest through subsidies and development projects. Between 1981 and 1996, processing capacities increased by a factor of 13 and production increased by a factor of only 4.5 (Bélières and Touré, 1999). As a result, in 1996, the SRV had the capacity to process 164,000 tons of paddy but production reached only 75,000 tons. These figures include the development of small-scale processing units, which were paying paddy quickly and in cash (Bélières and Touré, 1999). Rice growing was funded by CNCAS. Only 2% of farms took out a loan from a *banabana* in 2005 (Fall, 2006).

From 1994 to 1995, the share of paddy processed by industrial units decreased from 62% to 11%, while small-scale units developed their activity (Bélières and Touré, 1999). From 1996 on, industrial units became unprofitable because of marketing subsidies being withdrawn, bad harvests, strong competition

[34] Fixed exchange rate is: 1 euro = 655.957 FCFA.
[35] CFA : Communauté Financière en Afrique.

from small-scale units, high depreciation costs and a collapse in rice prices due to international competition (Bélières and Touré, 1999). This led to a concentration of the midstream segment. Some rice millers were able to continue obtaining supplies thanks to their relational proximity with producers and their ability to pay them quickly (Bélières and Touré, 1999). The governance changed from state hierarchy to spot transaction with a relational tendency. Local rice was of lower quality than imported rice because *banabanas* did not use moisture meters when purchasing their paddy, and they used simple husking techniques.

5.3. A favourable context supporting modernisation since 2007

It was recently demonstrated by experiments that local rice can compete with imported rice if its quality is adapted to the preferences of consumers, these preferences being aroma, homogeneity, purity of the grains, branding, and labelling (Demont and Ndour, 2015; Demont et al., 2013). Demont and Rizzotto (2012) proposed a three-stage policy sequence for modernizing the Senegalese rice VC. The first stage focuses on enhancing rice quality, though contracts, improvement of post-harvest practices and investments in modern techniques. The second stage is an increase in scale, through investments in storage infrastructure and increasing the working capital of the millers. The third stage is advertising to accelerate the transformation of consumer preference for domestic rice.

Such a sequence of action was implemented to a certain extent from 2008 on. The inter-ministerial council set up a national programme for rice self-sufficiency (MA, 2009). It aims at expanding land capacities and improving credit for production, processing and marketing. Several organisations such as AfricaRice have been working for many years at improving the seed used by producers. The Japanese International Co-operation Agency (JICA) has set up projects to improve processing techniques, secure processor supplies and promote local rice. CNCAS, SAED and USAID are helping producers and processors to better co-ordinate their activities to make higher quality rice available by setting up marketing contracts. Furthermore, the Millennium Challenge Account programme rehabilitated and extended the road network and irrigation infrastructures in 2010 (Embassy of the United States of America, 2010).

The food price crisis that started in 2007 on global markets increased the competitiveness of Senegalese rice. Thai rice prices (A1 grade) increased from US$270 to US$516 per ton between 2007 and 2012, peaking at US$850 in May 2008 (See Figure 5 in Appendix, data from Osiriz, 2017). That was an incentive to invest in processing techniques. Nevertheless, millers faced marketing difficulties when world prices decreased in 2014 to almost their pre-crisis level (US$309 in January). The state intervened in March 2015 to ensure the marketing of domestic rice through the implementation of an agreement between

importers and rice millers (SAED, 2015a): Importers committed to purchase 100% of standard broken rice processed by industrial millers and 30,000 tons of whole-grain rice. *Banabanas* were not included in the agreement.

Volumes of paddy increased from 200,000 tons during the 1990s to 415,000 tons in 2014. Six Senegalese processors used previous benefits and sometimes subsidies from development agencies to invest in techniques that give higher yields and perform more functions, including cleaning and grading. Two foreign processors were granted access to land and invested in similar techniques. Husking capacities reach three tons per hour.

6. Modernisation of the value chain

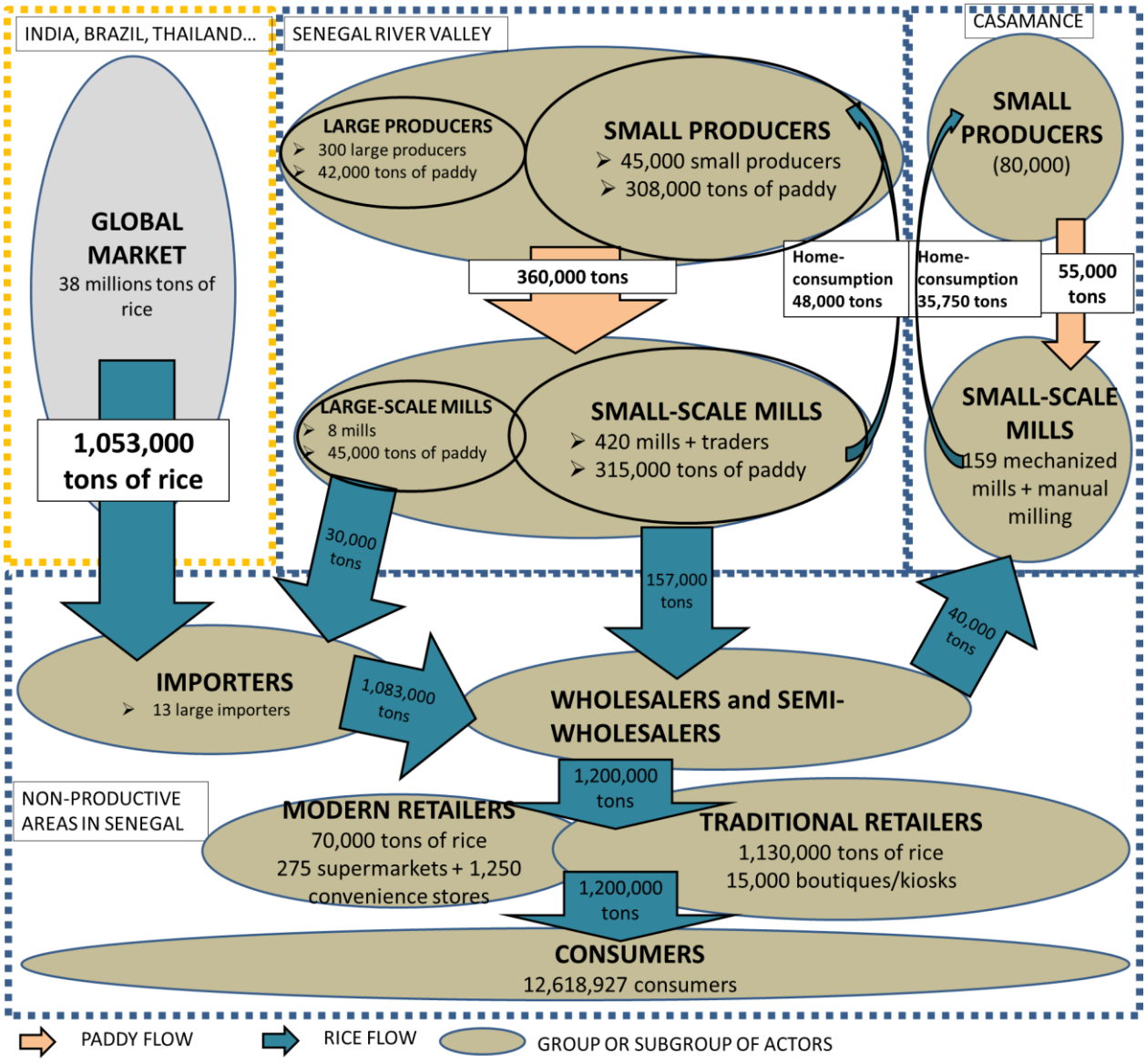
6.1. Present structure of the rice value chain

The SRV accounts for 80% of the national production of rice (USDA, 2015), the remainder being produced in Casamance. In 2014, 60,000 irrigated hectares were cropped in the SRV, 54% in the dry season (SAED, 2015b). According to the farmer survey, yields averaged 6.6 t/ha during the dry season and 5.3 t/ha during the wet season. 360,000 tons of paddy were produced in the SRV. Most of it comes from small-scale producers, who numbered 45,000 in 2008 (Gergely and Baris, 2009). 86.5% of farmers grew Sahel 108, which is an ordinary variety. 64.63% of producer organisations collected one variety, and the others separated varieties into lots.

In 2014, eight industrial and semi-industrial rice millers processed each between 2,000 and 13,000 tons of paddy, for a total of 45,000 tons. These figures represent between 38% and 75% of their individual technical capacity. Indeed, the volumes of paddy husked are constrained by the volumes of paddy rice millers are able to purchase. The rice supplied has high quality, with a low impurity content and humidity facilitating cooking. Whole grain rice and broken rice are distinguished. In parallel, 420 small-scale units husked 87% of paddy produced in the SRV in 2014. They processed on average 750 tons of paddy with techniques restricted to the husking function. They purchase the same paddy as industrial rice millers but only market broken rice which may contain impurities. The *banabanas* include small-scale traders paying for the husking service and selling rice on to wholesalers. Medium- and large-scale millers stated processing rates averaging 66%, while small units reported less than 65%. Since the rural population in the valley stands at 500,954 persons (ANSD, 2015) and per capita rice consumption in Senegal is 95 kg/year (Fofana et al., 2014), the valley supplied 187,000 tons of rice to the rest of Senegal. In 2014, the national production of 271,750 tons of rice was rounded out by 1,053,000 tons of imported broken rice, through 13 importers, mainly from India (598,000 tons), Thailand (197,000 tons) and Brazil

(52,000 tons) (USDA, 2015). Therefore, Senegal produces around 20% of national consumption. Whole-grain rice represented 2% of rice consumption in Senegal in 2014 (Hathie and Ndiaye, 2015) and imports of such rice reached 10,000 tons. Since March 2015, following government intervention, importers committed to purchase the rice from the SRV processed by industrial millers (SAED, 2015a). They sell local and imported rice to wholesalers and semi-wholesalers. A total of 15,000 small boutiques, kiosks, and traditional open-air markets (USDA, 2013) sell almost 95% of the rice volume (Gergely and Baris, 2009). Some 250 to 300 supermarkets in Senegal and between 1,000 and 1,500 other modern retailers sell the remainder. The structure of the rice VC in Senegal is summarised in Figure 2.

Figure 2: Structure of the rice value chain in Senegal

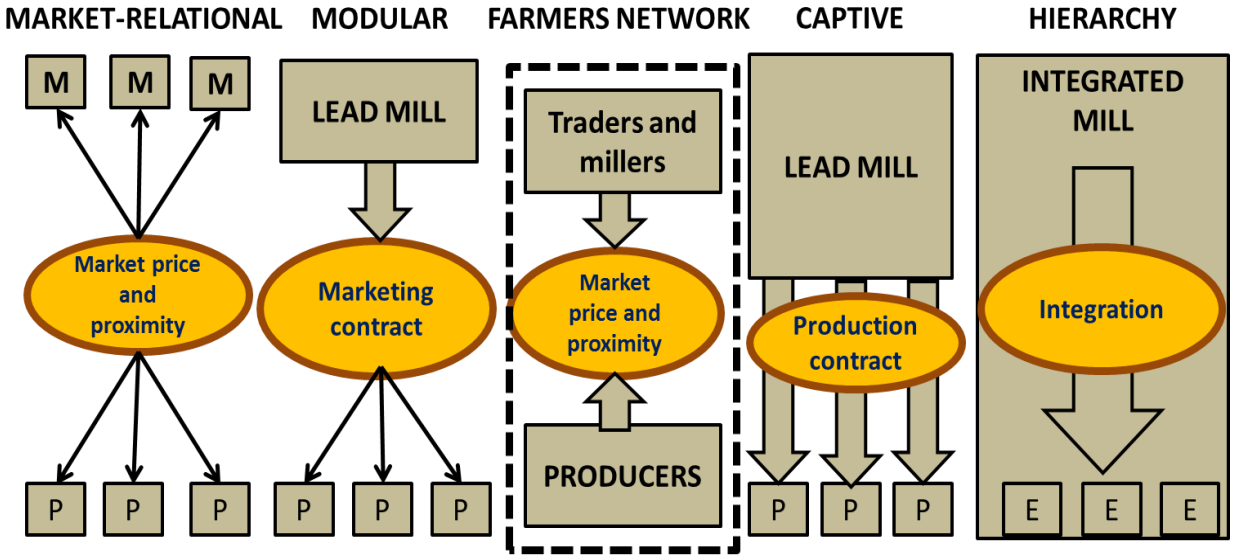


Source: The authors

6.2. Governance tending toward integration

Governance between rice millers and producers is a major stake for the upscaling of modernisation (Demont and Rizzotto, 2012). In 2010, there were neither marketing nor formal production contracts. Then, new co-ordination modes were set up to secure the supplies of rice millers. In 2014, production and marketing contracts represented each 5% of the volumes produced in the SRV, while vertical integration represented 2% and farmer networks 1%. Millers and producers may combine these types of governance. Figure 3 summarises the co-ordination modes.

Figure 3: Governance modes between producers and processors within the rice value chain



P: Producers; E: Employees; M: Mills

Source: Adapted from Gereffi et al. (2005)

6.2.1. The marketing contract: modular governance

Marketing contracts are written agreements specifying the marketing price and the quality of paddy. They were set up and are increasingly promoted by CNCAS and SAED. CNCAS indicates to millers which producers have taken out a loan. The contract price takes into consideration the suggested price negotiated within the inter-professional organisation, the moisture content, consistency of varieties and level of impurities. The average selling price through marketing contracts in the 2014 dry season was 126 FCFA per kilogram. There is no premium since the purchasing price through spot transactions was 124.5 FCFA/kg. In 2014, marketing contracts were used by 98 producer organisations growing rice on around 4,000 ha and including around 2,000 small-scale producers. All of them had access to credit from CNCAS. A total of 15,000 tons of paddy was purchased through marketing contracts in 2014. Payment is

made directly by millers to the bank account of the PO, from which the loan reimbursement is withdrawn. Millers sell the rice by grade and sometimes aroma, and a brand marker enables the consumer to identify which firm did the milling.

6.2.2. Farmer networks: Relational governance driven by farmers

Farmer networks involve various organisations such as semi-industrial mills owned by producer organisations or farmer associations linking producers and traders. These networks were set up after liberalisation by SAED, development agencies and non-government organisations. Four hundred producers are members of these networks, which sometimes also manage a credit union. Purchasers of paddy are also from the same network. Networks that do not own a mill subcontract the husking. Co-ordination between producers, traders and husking service providers is set up through the network, with high levels of relational proximity. Stakeholders reported there were increasingly fewer farmer networks because of deficit.

6.2.3. The production contract: Captive governance with some relational aspects

Production contracts were set up by rice millers. They are written out with an explicit accounting of the inputs. Producers are financed through credit extended in cash or the provision of seed, fertilisers and sometimes mechanised services by millers. Producers have to sell to the miller the quantity of paddy equivalent to the credit in cash or kind. If the producer does not reimburse the credit, this is generally followed by new negotiations with the rice miller. There is a common definition of quality based on moisture and impurity content. The rice is sorted by grade, and a brand enables the consumer to identify the rice miller. Millers may also provide agricultural advisory services. In 2014, production contracts were used by 71 producer organisations growing rice on some 3,500 ha and including around 1,500 producers. 15,000 tons of paddy were purchased through these contracts. The average purchasing price during the dry season was 104 FCFA per kilogram. Rice millers explain the lower price relative to spot transactions because of a higher risk of non-reimbursement from producers. Indeed, 87.1% of producers who used a production contract during the 2014 dry season were excluded from credit from the national bank because of non-reimbursement of previous credit. 86.6% of producers interviewed who entered a production contract stated that it was their only opportunity to obtain credit.

6.2.4. Vertical integration: Hierarchical governance

Four processing units were vertically integrated in 2014. They cropped between 20 and 800 ha. Three of these units received support from development agencies. They get access to the land through the local council or rent it from producers. They hire seasonal and daily workers. Around 8,000 tons of the paddy

processed by industrial units in 2014 were self-produced. A label with a brand enables the company to be identified.

7. Increase in total net margin

Taking into account prices of imported broken rice, we compare the distribution of costs and margins. The traditional VC supplies low quality rice, defined as rice containing heterogeneous grain sizes, impurities and different humidity rates. The brand *riz de la vallée* does not make it possible to identify the miller. The modern VC supplies high-quality rice defined as rice with a uniform grain size and rate of humidity, easy to cook and with a low rate of impurities. The consumer can identify the miller through the brand.

The four modes of vertical coordination that we previously presented relate to the modern VC. In 2014, the share of total net margin in the final retail price of broken rice reached 35.4% for the traditional VC and 35% for the modern VC (Table 1). In the case of whole-grain rice, the share of the total net margin was 43.9%.

Table 1: Distribution of margins (FCFA/kg) based on category of rice quality (2014) in the domestic value chain[36]

	Market governance	Vertical coordination	
	Broken rice, low quality	Broken rice, high quality	Whole-grain rice, high quality
Share of total margin in final retail price	35.4%	35.0%	43.9%
Distribution of total margin			
Producer share	60.6%	56.2%	38.3%
Processor share	9.4%	14.1%	34.2%
Wholesaler share	4.6%	8.7%	7.1%
Retailer share	25.4%	21.0%	20.4%

Source: The authors

[36] Margin is the difference between total income from selling and production costs, including capital depreciation.

Table 2: Distribution of costs and margins (FCFA/kg) based on category of rice quality (2014) [37]

	Market governance		Vertical coordination			
	Broken rice, low quality		Broken rice, high quality		Whole-grain rice, high quality	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Producer margin	58.00	2.46	56.00	2.76	56.00	2.76
Land preparation	20.20	5.11	19.40	2.91	19.40	2.91
Seeds and chemicals	35.70	7.32	34.30	6.48	34.30	6.48
Irrigation	20.30	7.99	19.50	5.26	19.50	5.26
Harvest and threshing	37.00	15.23	35.60	10.01	35.60	10.01
Other production costs	17.80	10.07	17.20	7.94	17.20	7.94
Processor margin	9.00	8.04	14.00	13.9	50.00	37.22
Capital depreciation, maintenance and repairs	5.00	2.50	16.60	14.4	16.60	14.4
Energy	11.10	8.16	7.20	2.09	7.20	2.09
Manpower	6.20	4.42	6.70	4.5	6.70	4.5
Others processing costs	2.70	1.15	5.50	12.94	5.50	12.94
Importer margin			5.40	2.05	6.00	2.05
Importer costs			2.00	2.98	2.00	2.98
Wholesaler margin	4.40	0.35	8.70	0.67	10.30	0.98
Wholesaler costs	1.00	0.54	1.50	3.23	1.90	3.23
Retailer margin	24.30	3.54	20.90	2.25	29.80	1.04
Retailer costs	17.70	1.84	14.20	2.4	14.40	2.4
Final retail price	270.30		284.70		332.50	
Total margin (FCFA)	95.7		99.6		146.1	

Source: The authors

[37] The opportunity cost of a production factor for which there is no local market is its production cost. The opportunity cost of a production factor for which there is a local market is its potential market price during the period considered (Boussard, 1987). The opportunity cost of land rental is FCFA 40,000 per hectare. That of manpower is FCFA 500 per day during the whole season except for harvest, when the cost is FCFA 1,500 per day. Transportation of seed, fertilizers and herbicides costs zero but transportation of bags of paddy costs FCFA 50 per bag. Seasonal workers are usually provided with board, which costs FCFA 5,000 per month. Some workers and the use of a threshing machine are often paid in paddy, in the field, during the harvest period. The opportunity cost of paddy is FCFA 75 per kilogram. This value is important since in-kind payment for threshing generally represents around 10% of production costs.

The rate of transformation is 65% for the traditional VC and 66% for the industrial one.

Costs for importers, wholesalers, and retailers include transportation, manpower, storage and credit. In the case of semi-wholesalers and retailers, storage costs were calculated on the basis of the space dedicated to rice.

Producers do not have premium and higher margin when selling to industrial millers because they supply paddy of similar quality to the one sold to small-scale millers. The main determinants of their production costs are harvest, threshing, seed and fertilizers. The margin of industrial millers is slightly higher with high-quality broken rice (14FCFA/kg) than that of *banabanas* (9FCFA/kg). The margin of industrial millers increases with high-quality whole grain rice (50FCFA/kg). Nevertheless, due to different technical and organisational conditions, particularly the volumes of paddy purchased, standard deviations of their margins are high (see Table 2).

The purchasing price of imported broken rice in 2014 is 225.6FCFA/kg at importer level. The traditional VC is able to compete since *banabanas* sell broken rice to traders at 223FCFA/kg. But modern millers suffered from competition with imports prior to state intervention because they provided broken rice of a quality similar to the imported one at a higher price (232FCFA/kg). That is why state intervention was necessary to enable the marketing of domestic industrial rice by constraining importers to purchase rice from modern mills (SAED, 2015a). The final retail price of broken rice is higher for the modern VC (284.7FCFA/kg) than the traditional one (270.3FCFA/kg), and whole grain is more expensive (332.5FCFA/kg) than either of them. The price of ordinary broken imported rice ranged in 2014 between 260 and 275 FCFA/kg, and the one of imported fragrant whole grain rice ranged between 300 and 350 FCFA/kg (Hathie and Ndiaye, 2015; François et al., 2014).

We find that in 2014 the traditional domestic VC was able to compete with imports of broken rice, although it supplied rice of lower quality. On the contrary, the modern VC was not able to compete with imports although providing similar degree of quality. Large-scale processors stay in business thanks to state intervention.

8. Discussion: A Senegalese quiet revolution?

The Asian and Senegalese modernisations have similarities. In both continents, policies fostered the modernisation, with investments in infrastructure, land development, research and extension and at times support to technical change. The use of intensive inputs by producers had been supported during the 1980's. The midstream segments recently underwent a technical change, and set up packaging and branding. There is an 'emerging vertical integration/co-ordination' in Asia (Reardon et al., 2014, p11) and we find the same pattern of governance in Senegal. Within the VCs, midstream actors define the quality criteria of paddy in link with the technique they use. VCs on both continents supply distant urban areas. The modernisation of the VC in Senegal is at its early stage, still expanding, as it is the case in Bangladesh (Reardon et al., 2012). The increase of the total net margin along the chains benefits the midstream segment, which obtains a higher share.

Nevertheless, the drivers and dynamics of the modernisation in the selected Asian countries and in Senegal are different in some respects. First, the benchmark situation is different. In Asia, it concerns tied credit-output transactions between producers and village traders (Bell and Srinivasan, 1989; Lele, 1971). Thanks to infrastructure improvements and income from non-agricultural activities, farmers became able to fund agriculture; interlinked transactions have disappeared. In Senegal, the state has used credit to support production since the country's independence (1964), through the distribution of inputs by SAED and then credit managed by the national bank. Consequently, tied credit-output transactions in Senegal were much less common than in Asia, and producers marketed their paddy through spot transactions with relational tendency (Fall, 2006). Furthermore, in Asia, the collection function, carried out by small-scale traders, was integrated by large processors (Reardon et al., 2012). In Senegal, this function was performed by processors before modernisation.

Second, in Senegal, credit policies directly contribute to the tendency of governance towards integration. Marketing contracts were introduced to respond to the requirements of the millers concerning the quantity and quality of paddy and to guarantee reimbursement to CNCAS. Production contracts were introduced by rice millers to ensure the quantity and quality of their supplies. Most producers entering a production contract were excluded from credit with the national bank because of non-reimbursement of previous credit. The production contract is similar to informal credit arrangements because screening, monitoring and enforcement are not rooted in the law but in geographical and relational proximity. The main difference between both arrangements is that production contracts are written out and transactions are complex in terms of paddy quality.

Third, the modernisation of the rice VC in Senegal does not make it competitive relative to imports of broken rice. Indeed, broken rice is a by-product sold at low prices on global markets. On the other hand, the volumes processed by modern millers in Senegal are limited because they do not pay a premium. As a result, the quantity of paddy processed by industrial rice millers seems linked to the credit obtained by farmers through marketing contracts and production contracts. The low volume of paddy processed generates high capital depreciation costs per kilogram and impedes the competitiveness of the modern rice VC relative to imports. Large-scale processors stay in business and get a high share of the margin thanks to state intervention. As a result, Senegal is self-sufficient at around 20%, and the modern domestic VC supplies 2.6% of national consumption. This is a major difference with the People's Republic of China, India and Bangladesh, which are close to self-sufficiency.

Another difference is that the supermarket revolution does not seem to be occurring in Senegal, with limited modern retailing (Hathie and Ndiaye, 2015). The common and distinctive features of chain modernisation in Asia and Senegal are summarised in Figure 4.

Figure 4: Comparison of modernisation between selected Asian countries (Bangladesh, India, the People's Republic of China) and Senegal

		Selected Asian countries (Reardon et al., 2012)	Senegal (our data)
Institutional environment	Link to global market	Supplier or independent	Purchaser, competition from global markets
	Policies	Support for modernisation: infrastructure, research and extension	Support for modernisation: infrastructure, research and extension, credit policies
Organisation of the chain	Small-scale producers	Increase in production	
	Processing	Technical change and concentration	Technical change and expansion
	Retailing	Supermarket revolution	Traditional retailing dominates
	Geographical distance	Increasing	
	Number of intermediaries	Decreasing, integration of collection	Direct relationships between producers and processors existed before modernisation
	Governance	From interlinked transactions to integration; midstream segment becomes the driver	From market governance (with relational tendency) to integration. Midstream segment becomes the driver (with policy support)
Performance	Volumes	Modern value chains dominate in People's Republic of China and India and are emerging in Bangladesh	A modern value chain is emerging
	Quality	Increase in quality	
	Margins	Increase in total net margin and share obtained by the midstream segment	
	Final price	The modern value chains are competitive with imports	The modern value chain is not competitive with imports

Source: Reardon et al. (2012) and the authors

9. Conclusions and policy recommendations

In India, Bangladesh and the People's Republic of China, the modernisation of domestic VCs is brought about by the midstream segment as it implements technical change and integrates new functions (Reardon et al., 2012). In certain African countries, there are policies aiming at modernising domestic food chains to reach self-sufficiency, but there is still little evidence making it possible to determine if the same modernisation is happening. We proposed to investigate whether the rice VC in Senegal has the same modernisation features as the quiet revolution. We made use of the GVC theoretical framework (Gereffi et al., 2005), which highlights the influence that one stakeholder in a steering position can have on the distribution of tasks and skills. The dynamics of governance were analysed from a historical point of view, based on previous research and 154 in-depth qualitative interviews. Based on quantitative surveys with 913 VC actors, we also analyse the competitiveness of the VC, particularly in terms of quality of product, quantity supplied, costs of production, margins and final prices.

Public policies and links to the global markets have influenced the governance of the VC over the decades. The rice VC was set up by the government in 1964, with intervention in industrial processing and wholesale trade. During the 90's, the privatisation of the VCs and opening up to global markets was favourable to the development of small-scale processing units, functioning at lower cost. Between 2008 and 2014, the price increase on the global market, and the policies implemented in response, were favourable to the modernisation of the VC, in addition to the domestic demand for quality produce (Demont and Ndour, 2015).

Processors, sometimes with the support of policies, invested in techniques that improve yields and quality, and set up new modes of co-ordination. Governance tends towards integration since there is an increase in the share of paddy marketed through contracts and in the share of the production vertically integrated. We therefore find that the rice VC is undergoing modernisation as described by Reardon et al. (2012). Nevertheless, the main differences are that in Senegal, (1) the benchmark situation between producers and village traders is a spot transaction with relational tendency (and not a tied credit-output transaction), and processors collected paddy before the modernisation, (2) credit policies directly contribute to the tendency of governance towards integration and (3) the modernisation of the rice VC is not competitive with imports of broken rice.

The main stages of the policy sequencing recommended by Demont and Rizzotto (2012) to modernise the VC were implemented. Nevertheless, the modernisation faces difficulties in moving from the quality improvement stage to the quantity increase. Indeed, the quantity of paddy processed by industrial rice millers is linked to the quantities of paddy needed to reimburse farmer credits in the framework of marketing contracts and production contracts. It generates high capital depreciation costs per kilogram and impedes the competitiveness of the modern rice VC relative to imports, as in 1995. Furthermore, the modernisation is based on the concentration of the processing segment, and includes little the traditional processing sector.

In order to improve the competitiveness of the modern domestic VC with imports, we first recommend the inclusion of small-scale processors in the modernisation through the promotion of semi-industrial techniques and the opening up of operating and equipment loans. *Banabanas* operate at a low cost because they use simple techniques. They have a network of suppliers with whom they engage in spot transactions with relational proximity. Relational proximity generates trust and reduces the risk of non-payment (Moustier, 2012). Spot transactions provide flexibility in marketed volumes and enable quick payments. Nevertheless, these small-scale processors face two major constraints to supply good quality rice. The first one is technical, since their processing units only perform the husking function. The quality of their production may be improved by supporting their access to compact unit rice millers (Cruz, 1999), which separate the hulling and blanching operations, and may be coupled with manual graders. Such semi-industrial techniques would increase processing yields and bring the rice quality up to the level of industrial millers (Cruz, 1999). It would also enable small units to keep their flexibility and low operating costs. Nevertheless, the compact unit relies on the importing of rubber rolls, so national stocks need to be established. Furthermore, the cost of compact unit rice millers is more than FCFA 2 million, which is twice the price of units currently used by *banabanas*. Investment loans could be offered by CNCAS, with guarantees and insurance. The second constraint faced by *banabanas* is limited cash flow. This is an impediment to an increase in the volumes they trade and to quality improvement because they produce higher quality products when they trade rice rather than when they do custom milling. Quantities and quality could be developed if they had access to credit. We therefore recommend the offer of operating loans to *banabanas*, as has been done for industrial processors. These recommendations to put forward policies to include small-scale millers in the modernisation are similar to Waldron et al. (2010) who advocated incremental development in the case of the beef industry in China.

Second, policies in Senegal could help reduce agricultural production costs through small-scale mechanisation. Indeed, harvest and threshing represent 28.25% of farmer production costs and 12.5% and 13.68% of the final retail price of broken rice from the modern and traditional VCs. Only 2.66% of small-scale producers used a combined harvester during the dry season 2014. The use of such techniques could decrease production costs. Nevertheless, there are strong issues of collective action which could hinder the efficiency of using combine harvesters, whether they are handled by farmer organisations or provided by private companies. Specific feasibility studies should consider small-scale mechanisation, which was effective in Asia.

Another issue highlighted by the paper is that the private interests of rice millers are not always in line with the goal of national self-sufficiency policies. Whole-grain rice in Senegal is a niche segment which will be rapidly filled by domestic production. Since margins are higher for this type of rice, industrial rice millers will try to identify new markets, probably in the region. That rationale contradicts the national policy, but not the one followed by Economic Community of West African States, which relies on better integrated regional market to ensure food security in West Africa.

The main limits of this research concern the conceptual framework and the orientation of the analysis of the VC on the upper and midstream segments. We mainly use the governance framework whereas the Asian quiet revolution was highlighted using the Structure-Conduct-Performance paradigm. Furthermore, we focus the analysis on relationships between upstream VC stakeholders. Drivers from the downstream segment of the VC could also influence the modernisation.

TRANSITION 1: FROM THE GOVERNANCE OF THE CHAIN TO THE INCLUSION OF PRODUCERS

The previous chapter shows that in Senegal rice millers are investing in large processing capacities and increasingly get their supplies of paddy through contract farming agreements and hierarchical control of the production. The effects of these forms of coordination on small-scale producers must be investigated because they are expanding in sub-Saharan Africa. Indeed, large-scale investments are encouraged by certain development organizations in order to increase agricultural production (FAO, 2015). Schoneveld (2014) identified that between 2005 and 2013, 563 investments integrating agricultural production concerned surfaces above 2,000 ha, for a total of 22,727,457 ha. Furthermore, "the proportion of farm households involved in contract farming is probably in the range of 1–5 percent" (Minot and Sawyer, 2016, p136, based on a literature review). Contract farming is even more developed in certain countries, such as in Benin where contracts concerned 34% of cotton growers (Minot and Daniels, 2005).

In the case of export chains of high-value products, some literature reports positive impacts from contract and employment (see for instance Maertens et al., 2011; Maertens and Swinnen, 2009). The analysis of what drives the inclusion of small-scale producers in contract farming or in employment for firms vertically integrated is therefore important. In the following chapters, I focus on contract farming which was the form of coordination involving the highest number of small-scale farmers in the rice VC in Senegal in 2014. The chapter 6 in appendix 3 (in French) notably questions the effects of vertical integration on small-scale producers through employment.

Firms prefer to contract with producers with whom transaction costs are the lowest. For this reason, they select farms meeting specific criteria, for instance those with the highest land size, the most experience, etc. (Barrett et al., 2012). This selection on certain criteria risks fueling a dynamic including the wealthiest producers and excluding the less endowed, thus generating a poverty trap. Some papers highlight a sequential model of small farmer participation in contract farming (Barrett et al., 2012; Reardon et al., 2009) that I describe further.

Nevertheless, there is a need for additional studies about contract farming in domestic grain chains. Indeed, contractual arrangements in domestic grain chains are less likely to appear because the demand for a high-quality product is limited and the low perishability eases side selling (Swinnen et al., 2010). Nevertheless, the literature starts documenting cases of contracts in domestic chains improving farmer income (Maertens

and Vande Velde, 2017; Alemu et al., 2016). Furthermore, the combination of marketing modes involving contracts and spot transactions by small farmers is often cited but not analyzed (Rao and Qaim, 2011; Da Silva, 2005; Gow and Swinnen, 1998, 2001). This combination may be part of an overall livelihood strategy of producers, whether it is deliberate or constrained.

In the following chapter, I aim at answering the following questions, for which there are some gaps in the literature. What are the drivers of inclusion of small-scale food producers in contracts? Are there barriers to entry for them? What are the advantages and disadvantages of sales through contracts and through spot transactions? Why are producers combining both? And to what extent is it a part of their livelihood strategies?

CHAPTER 3: PLURAL FORMS OF GOVERNANCE AND AGRICULTURAL FINANCING—THE CASE OF THE DOMESTIC RICE VALUE CHAIN IN SENEGAL

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1. Introduction

The transformation of the agrifood system in developing countries is characterized by consolidation, multinationalization, specialization and changes in institutional arrangements (Reardon et al., 2009). Agrifood companies have invested in technologies to improve the quality of products and have created private standards and grades of quality and safety. They also integrated their supplies through contracts, which seems to increase small-scale producer incomes (for a review, see Bellemare and Novak, 2014; Wang et al., 2014). Contractors support these producers in improving the quality of their products through access to inputs and technical advisory services (Jaffee et al., 2011; Reardon et al., 2009; Eaton and Shepherd, 2001). Contracts increase yields (Brambilla and Porto, 2011), farm gate prices and incomes.

This literature concerns export value chains (VC) (Swinnen and Maertens, 2007). Meanwhile, the literature on domestic food chains in Africa and Asia documents traditional VC in which numerous intermediaries use simple technology, supply products of varying quality and generate little added value (Hugon, 1988; Lele, 1971). Innovation is limited due to a low price incentive on end markets (Jones, 1974). Domestic VCs operate in an uncertain institutional environment, including deficient policies, poor-quality infrastructure, climate variations and insecurity. Farmers face failures on financial services, inputs and outputs markets (Key and Runsten, 1999; Grosh, 1994). Commercial banks do not often lend to small-scale producers because of their lack of collateral security (Bardhan, 1980). As a result, financial services are often carried out by interlinked relationships, with the aggregator funding farmers in cash or in inputs, at high rates of interest (Fafchamps, 2004). Relational proximity generates trust (Minten et al., 2016) but may yield an unbalanced distribution of benefits (David and Moustier, 1998). Nevertheless, these domestic food chains are able to supply cities competitively (Duteurtre, 2007; Cadilhon et al., 2006) and provide outlets for heterogeneous products (Guarín, 2013). There is no barrier to entry, no collusion leading to market concentration (Bauer, 1955) and the coordination through networking may be more transparent than through the market (Galtier, 2002).

But some domestic food chains seem to be modernizing in Asia and Africa. Recent research highlights the transformation of the rice and potato chains in India, Bangladesh and People's Republic of China (Reardon et al., 2012). The modernization is characterized by the concentration of the midstream segment, which invests in new techniques and sets up new coordination modes (Reardon et al., 2012, 2014; Minten, Singh, et al., 2013; Reardon and Minten, 2011). Institutional innovations include the integration of the collection function by processors, and in certain cases contract farming. In sub-Saharan Africa, similar transformations

seem to be going on (Reardon et al., 2013). Following the first world food price crisis, governments set up new programs aiming at modernizing domestic VCs to reach self-sufficiency (Fofana et al., 2014). In Senegal, rice millers implement a technical change and increasingly use contracts with small-scale producers (Soullier and Moustier, 2015).

The question of the drivers of small-scale producer inclusion in contract farming has important implications for development. Barrett et al. (2012) proposes a sequential model. First, the firm selects the area based on its infrastructure and agro-ecological characteristics. Second, it offers a contract to certain producers, usually those with the largest area (Kirsten and Sartorius, 2002; Key and Runsten, 1999), endowed with non-land assets and who diversify with non-agricultural activities (Birthal et al., 2005). However, unequal inclusion may be mitigated when farms are of similar size, as well as by competition between purchasers. It may also be mitigated by farmer organizations and policies (Barrett et al., 2012). Third, smallholders may agree to contract or not, based on their expectation of gain, which takes into consideration access to credit, price premiums, inputs, information, economies of scale, risk reduction and knowledge acquisition (Bellemare, 2012; Key and Runsten, 1999). Finally, both partners decide to comply with the delivery and payment terms, which will determine whether a new contract is set up or not.

Contract farming literature considers that producers are either included in traditional VCs through spot transactions or in modern VCs through contracts. Nevertheless, the combination of both modes of governance is often observed without questioning its rationale (Rao and Qaim, 2011; Da Silva, 2005; Gow and Swinnen, 1998, 2001). Such combination of marketing modes may be part of an overall strategy of farmer livelihoods because the different modes of coordination may fill different functions. Nevertheless, evidence regarding the reason for such a combination is limited. Masuka (2012) analyzed the engagement of cotton seed producers in contract and spot transactions in Zimbabwe. In the context of thin input and credit markets, producers participated in contract farming to obtain access to both. Contracts provide access to credit, inputs, technical assistance, market assurance including price stability and dividends. But farmers also participated in spot transactions because they can be more remunerative due to competition between purchasers, and the payment is quick compared to a contract. Similar observations were made in the coffee VC in Rwanda (Mujawamariya et al., 2013) and Uganda (Bolwig et al., 2009), where farmers also sell coffee to local traders, with whom they have relational proximity, in order to get quick payment, credit for unexpected expenses, and outlets for products rejected by contracts.

The paper addresses the inclusion of small-scale producers in modernizing domestic food chains. It questions the strategies of small-scale producer participation in contract farming. It particularly addresses the issue of the combination of marketing modes by small-scale producers. The conceptual framework makes it possible to test the hypothesis that livelihoods and uncertainty drive plural forms of governance. The paper provides empirical evidence from the rice VC in Senegal, where some rice growers divide their sales between large husking firms with contracts and small-scale units through spot transactions.

Section 2 presents the theoretical framework. Section 3 explains the method. Section 4 presents results which are discussed in section 5. Section 6 concludes.

2. Conceptual framework

The Global Value Chain (GVC) framework (Gereffi et al., 2005) is linked to transaction costs economics. This framework acknowledges that asset specificity increases transaction costs (Williamson, 1985). It also acknowledges uncertainty (called complexity), which is a potential shock whose probability is unknown (Knight, 1921). Uncertainty differs from risk because individuals have bounded rationality. GVC acknowledges that governance ranges between the market and the hierarchy, and breaks down hybrid governance into three types. Modular governance refers to transactions that are complex in terms of quality, with suppliers who are able to meet different forms of demand. Relational governance describes transactions in which the actors are socially close, thus reducing uncertainty but also creating a situation of interdependence. Captive governance refers to the strong involvement of a leading firm in the operations of its suppliers, who become dependent.

GVC addresses more specifically than transaction costs economics the issue of producer participation in the VC because it has a specific interest in the capabilities of actual and potential suppliers to satisfy the transaction. It analyzes how innovation in quality makes transactions complex, and influences the power relationships between the driver of the chain and its suppliers. Included suppliers may be upgraded, that is to say may acquire new skills and access more remunerative markets (Humphrey, 2004). On the contrary, producers who do not meet the criteria for inclusion may be marginalized from pro-poor processes (Maertens and Swinnen, 2009). The different aspects of the endowment of farms in capital determine their inclusion (Barrett et al., 2012; Poole et al., 2007). According to the livelihoods approach (Scoones, 2009), these types of capital are physical (roads, technology, irrigation), human (gender, education, number of active members, etc.), social (links to leaders or to VC actors) natural (availability of water) and financial.

Financial capital includes household savings, on-farm and off-farm incomes (including remittances) and the ability to access other sources of funding. Vertical coordination in particular may bring about financial upgrading of producers. It may be producer driven, for instance through producer organizations that provide and manage access to credit (Miller and Jones, 2010). It may also be buyer driven, the most common practice being contract farming (Jessop et al., 2012). Access to new sources of finance may also be facilitator driven when fueled by government or non-government actors with a social mandate (ADB, 2013).

Recent developments in transaction costs economics address the combination of different coordination modes (Ménard, 2013). Plural forms of governance were first identified by Bradach and Eccles (1989) and are defined as "those organizational arrangements in which, for a class of transactions dealing with the same activity and within the same institutional and competitive environment, a party uses simultaneously different modes of governance or relies simultaneously on substantially different types of contracts" (Ménard, 2013, p125). Most research on the plurality of governance focuses on franchise agreements (Bigio Schnaider, 2016), and points to the role of uncertainty in the non-convergence of institutional arrangements. Recent theoretical development considers that the complexity of a transaction refers to the difficulty in evaluating the costs of governance modes, and may be generated by uncertainty, particularly concerning technology (Ménard, 2013). With an application in the Brazilian agrifood sector, Ménard et al. (2014) and Bigio Schnaider (2016) show that plural forms appear when uncertainty is combined with a minimum degree of asset specificity.

The theoretical framework described in the preceding paragraph considers that producers manage their marketing strategies based on their capital endowment and on the incentives provided by the VCs in an uncertain environment. The research question is: "What are the influences of livelihoods and uncertainty on plurality of governance?"

3. Method and data

3.1. Method

The papers considers two types of contracts : marketing contracts and production contracts (further detailed in Table 2). All producers involved in a contract also market through spot transactions. Participation in contracts is therefore equivalent to participation in plural forms. The reference group is made up of producers marketing paddy through spot transaction only.

Let us consider a multimodal logit model that explains the choice Y_{im} of producer i ∈ [1… N] between the marketing options M:

$$M = \begin{cases} 1 \text{ if the paddy is sold by spot transaction uniquelly} \\ 2 \text{ if the paddy is sold by marketing contract and spot transaction} \\ 3 \text{ if the paddy is sold by production contract and spot transaction} \end{cases}$$

The model is:

$$\text{Logit}[\Pr(Y_{im} = M)] = \alpha . I_i + \Upsilon . LH_i + \beta . X_i + \varepsilon_i \quad (1)$$

where α is the vector of parameters associated with the producer's perception of uncertainty forms I, ϒ is the vector of parameters associated with his livelihoods LH, β is the vector associated with his set of other characteristics X and ε_i is the normal error term.

These coefficients provide information on the significances and signs of influence of the independent variables on the dependent variable. Relative Risk Ratios are obtained with exponential parameters. Given that the other independent variables are constant, the interpretation of such ratios is the probability of a change in the dependent variable relative to the referent group (spot transaction). Multinomial logit models are valid under the Independence of Irrelevant Alternatives assumption that states that characteristics of one particular alternative do not impact the relative probabilities of choosing other alternatives (Hausman and McFadden, 1984). This test evaluates the difference in the estimates of parameters of two multinomial logit estimations.

Finally, multiple component analysis provides a typology of producers. This data analysis method calls upon categorical variables to represent their patterns of relationships. Discriminatory variables are producer characteristics which are the main drivers of participation in marketing modes.

3.2. Data

The rice VC in Senegal was selected because it presented patterns of transformation including the emergence of contract farming in Dagana Department (Soullier and Moustier, 2015). Following exploratory work, a cross-sectional survey addresses the participation of small-scale producers in contracts.

The producer organizations databases provided by the national agency in charge of rice development (French acronym SAED, *Société d'Aménagement et d'Exploitation du Delta*) and by rice millers were

stratified. Hydraulic unions that grouped producers growing a few hectares (53.66% of producers in the department) were selected. The producer organizations were stratified according to their modes of marketing, i.e. spot transactions, marketing contracts (and potential spot transactions) and production contracts (idem). Producer organizations participating in contracts were oversampled[38] to be sure of having sufficient inferences. Ninety producer organizations were randomly selected and oversampling was corrected during data processing. Six producers randomly selected from each producer organization were interviewed. Enumerators were trained for two weeks. The team used double keying in of data. Data were collected from April to June 2015, and the questions concerned the 2014 dry season (February-June 2014). The questionnaire queried farm characteristics (including diversification and assets), the organization of rice production (including financing and inputs) and the marketing of paddy.

Uncertainty on credit and food security was addressed by four point Likert scales (summarized in table 6 in appendix 1). Presidents of producer organizations were also interviewed in order to define the collective perception of the producers regarding uncertainty over collective access to credit, inputs and marketing.[39] Uncertainty perception is not influenced by participation in contract farming because contracts are very recent in the Senegal River valley (SRV). Uncertainty variables are treated as independent numerical variables in the trivariate model. Among the data collected, 22 observations were withdrawn because they were only included in contracts, without realizing spot transaction. The final sample contained 372 observations: 194 concerning spot transactions uniquely (the reference group), 105 concerning marketing contracts and spot transactions, and 73 concerning production contracts and spot transactions.

4. Results

4.1. The rice value chain prior contracts

State intervention has supported the development of the rice VC from the SRV since independence in 1964. The national agency in charge of agricultural development (SAED) carried out land development, provided producers with improved inputs and technical advice and managed two large-scale mills. Reimbursement was in paddy (Belières and Touré, 1999). The VC was liberalized in 1987 because of indebtedness. Producer

[38] The ratio of the contracted sub-samples to the contracted populations was six times higher than the ratio of the spot transaction sample to the spot transaction population.
[39] The president was interviewed to get the collective perception of members of various uncertainties because it was not possible to interview all producer organizations members.

organizations were established to enable collective actions in a system that still exists nowadays. First, producer organizations enable producers to access credit. A national agricultural bank (*Caisse Nationale de Crédit Agricole du Sénégal,* French acronym CNCAS) was created. Producers can obtain credit if they have reimbursed previous loans, have access to irrigated land and if the technical itinerary is validated by SAED. Nevertheless, the administrative procedure for issuing credit may be long. In 2005, little alternative to credit existed: diversification covered between 20% and 30% of rice production costs and only 2% of farms took out a loan from a small-scale processor (Fall, 2006). Second, producer organizations may purchase seed, fertilizers and herbicides from private traders or hydraulic unions. Since 1997, fertilizer has been subsidized by the government for producers using credit from CNCAS (at 50% since 2004) and the rate of interest reduced from 12.5% to 7.5% through subsidies. The production of seeds by producers and rice millers is supported by development agencies, but some producers do not trust the certification system. Third, once the paddy is harvested, producer organizations sell the paddy to reimburse the bank credit. Liberalization favored the replacement of large-scale mills by small-scale processors, called *banabanas,* who use simple techniques. They purchase paddy through spot transactions, from producer organizations or from individual producers, with whom they share relational and geographical proximity (Fall, 2006).

In addition to collective sales to reimburse the credit, producers perform individual sales through spot transactions (also with a relational tendency), according to the household's food and cash needs (Colen et al., 2013). Finally, there are individual farmers or producer organizations that self-finance rice growing and sell paddy to *banabanas* through spot transactions (also with a relational tendency).

The outcome of spot transactions is uncertain for various reasons. The quality of the paddy may decline between harvest and collection by the purchaser. It may also be difficult to identify a purchaser of paddy and this purchaser may not take the whole stock of paddy if different varieties are mixed or may be opportunistic and avoid paying. Furthermore, the marketing price of paddy is variable and may be low. Finally, inability to reimburse the credit might imply that rice production is not enough to feed the family up to the following harvest.

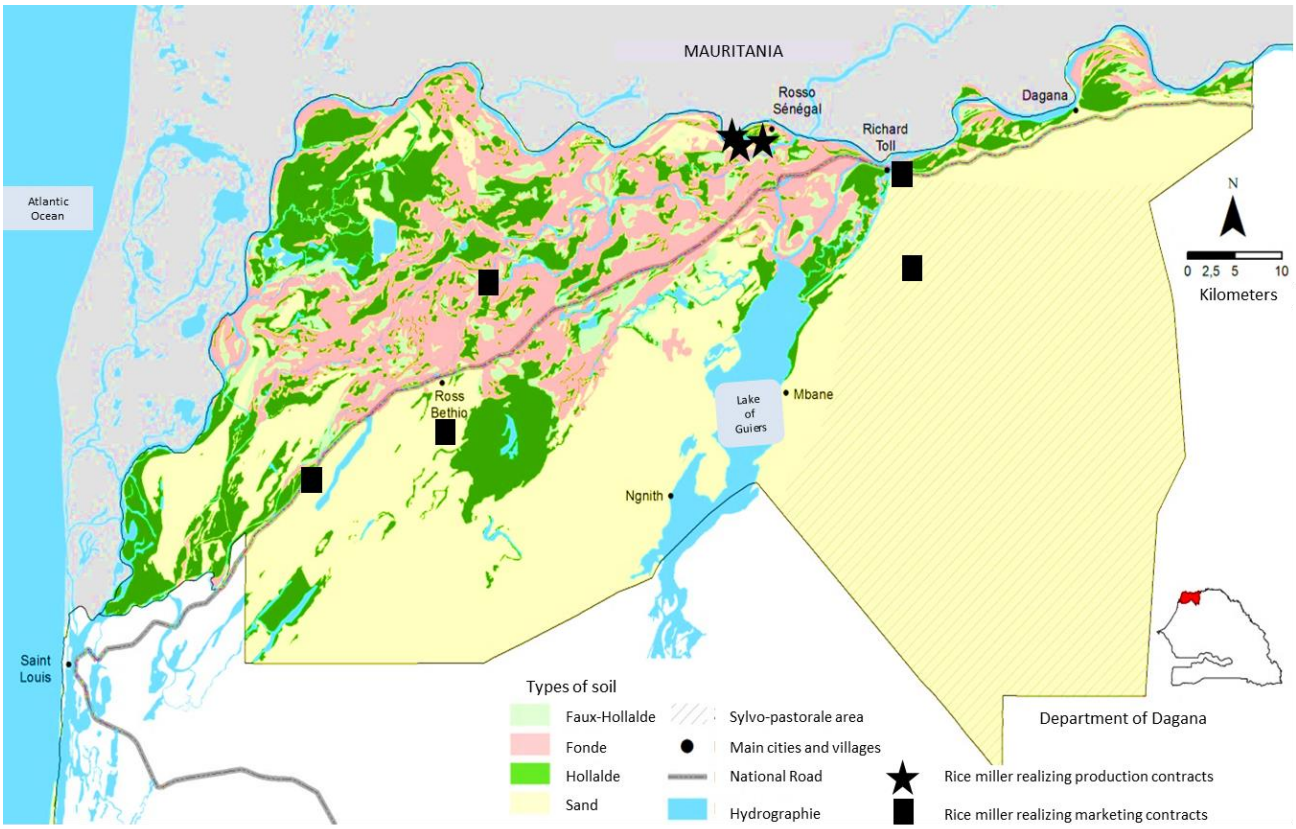
Since the establishment of the rice VC, financial organizations have had problems with the credit repayment. In the period 1981-–1988, credit provided by SAED reached FCFA 6 billion and the rate of reimbursement was 86% (Bélières and Touré, 1999). The creation of CNCAS did not reduce the deficit: credit increased to FCFA 5 billion in the 1990/1991 season and the reimbursement rate dropped to 65% (Bélières

and Touré, 1999). Since then, the government of Senegal has intervened four times to implement recovery plans. The last intervention cancelled FCFA 13.6 billion of debt in early 2014.

4.2. Location of rice millers

Rice millers who use contracts are located in the Dagana Department because it the core rice production region in Senegal (Figure 1). In 2014, 60,000 irrigated hectares were cropped in the SRV (SAED, 2015b), accounting for 80% of rice national production (USDA, 2015). Dagana Department includes the Senegal River Delta, which accounts for 93.5% of the 26,019 ha cropped by small-scale farmers in the 2014 dry season in the SRV. There were 45,000 small-scale producers in the SRV in 2008 (Gergely and Baris, 2009). A 140-km national road crosses the department from west to east, linking the coastal city of Saint Louis to Mauritania and Mali. This road was rehabilitated through the USAID millennium challenge account program in 2010. The main formal financial organization is CNCAS, which covers the whole department and beyond.

Figure 1: Dagana Department and location of rice millers in 2014



Between 2010 and 2014, eight rice millers invested in machines that husk, grade and clean the rice and sometimes have other functions (table 1). They husk up to three tons of paddy per hour. The millers choose their location based on geographical proximity to rice production areas. The nature of their contractual links with producers is based on their experience in rice growing. Millers who use marketing contracts are distributed across the department, close to the national road. Millers who use production contracts are concentrated in the village of Thiagar in the Delta in the north east of the department. They chose this village because it is close to the Senegal River Delta, to the paved road and it was where they themselves grew rice before investing in milling. As a result, the radius of the area in which the rice millers realize production contracts does not cover certain parts of the department. In 2014, each rice miller processed between 2,000 and 13,000 tons of paddy, i.e. a total of 45,000 tons. These were limited by the quantities of paddy they were able to collect. As a result, the traditional VC still dominates since in 2014, 420 small-scale units husked 87% of paddy, accounting for an average of 750 tons each (Soullier and Moustier, 2015).

Table 1: Characteristics of rice millers in 2014

Coordination modes implemented by rice millers	Spot Transaction	Marketing Contract	Production Contract
Number of processors	420	5	3
Processing technique	Husking only	Husking, cleaning, grading	Husking, cleaning, grading
Experience of rice miller in rice growing	Some have, some not	No	Yes
Volume processed in 2014	750 tons on average	Between 2,000 and 8,000 tons	Between 5,000 and 13,000 tons

4.3. Contract offer

With the “Feed the Future” program, USAID supports SAED and CNCAS by increasing the quantity and quality of rice supplied by the domestic VC. Marketing contracts were introduced in 2011 to respond to miller needs concerning the quantity and quality of paddy and to guarantee reimbursement of loans to CNCAS. Marketing contracts are part of the previously described formal system, in which they replace spot transactions. Supplies of inputs and technical support are the same as in the CNCAS system. With a marketing contract, millers pay what they owe the producers directly to the bank account of the producer organization, which then reimburses the credit. The contract price was on average 126 FCFA per kilogram in the 2014 dry season. It is based on the suggested price, negotiated within the interprofessionnal

association, which was 125 FCFA per kilogram. The price also accounts for the moisture rate (which must be between 12% and 14%), the consistency of the variety, and the proportion of impurities (which must be less than 1%). If the quality criteria are not respected, millers have the right to refuse the paddy or to reduce the purchase price. CNCAS promotes the use of marketing contracts by linking producer organizations and rice millers. Millers contract with producer organizations who have a credit with CNCAS, who are located within a distance of maximum 50 kilometers, and who can supply at least two tons of paddy. The interprofessionnal organization is the official enforcement institution. In the 2014 dry season, marketing contracts were used to sell 15,000 tons of paddy by 98 producer organizations, including 2,000 small-scale producers growing rice on a total of 4,000 ha.

Production contracts were introduced by rice millers in 2010, without the support of an external program, to ensure the quantity and quality of their supplies. Both rice millers and farmers can initiate the contract. They share relational proximity because the managers originate from the village and hire local workers. The contract is a written one, and includes the amount of inputs the miller provides to farmers: seed, fertilizers, herbicides and/or mechanized services. The miller may also implement the technical support and have the power of decision over irrigation and harvest. The quality of paddy required is the same as in a marketing contract. The miller does not have to pay producers because 100% of producer organizations participating in production contracts supply no more than the quantity of paddy equal to the value of the credit. Rice millers prefer contracting with farmers who cultivate large areas but also resort to producer organizations. They do not finance investments by the producers, who consequently must have prepared irrigated land. The millers reported a collection radius of 50 kilometres. When there is a conflict, producers and the miller renegotiate. In 2014, production contracts were used to market 15,000 tons of paddy by 71 producer organizations grouping 1,500 producers who grew rice on 3,500 ha.

Using credit from CNCAS, the farmer can benefit from subsidies on fertilizer and interest rates. Producer organizations then reimburse the credit by spot transaction or marketing contract. Prices are variable in spot transaction and steady in marketing contract. The contract limits the risk of opportunism from producers. Conversely, access to credit and inputs is easier and quicker with a production contract than from CNCAS, the latter involving long administrative procedures. Under a production contract, the quantity of paddy supplied by the producer to the miller is the exact equivalent of the amount of the credit, so the miller does not have to make any payments. Nevertheless, the sales price under a production contract is low compared to other marketing modes. Individual spot transactions may bring more than what is needed

for the reimbursement, and enable the farmer to adapt the amount of rice sold to the household's food and cash needs, as well as to benefit from higher prices, depending on the season. Table 2 sums up the characteristics of each type of transaction.

Table 2: Characteristics of the types of transactions

	Spot Transaction	Marketing Contract	Production Contract
Supplier of credit	CNCAS/No credit	CNCAS	Rice millers
Supplier of inputs	Trader	Trader	Rice millers
Subsidy	If credit from CNCAS	Yes	No
Payment of output	*Banabana* to producer(s)	Rice miller to CNCAS	No payment[40]
Price of paddy	High variability	Low variability	Low price and low variability
Flexibility of quantity sold	Only with individual sales	No	No

4.4. Participation of producers

Descriptive statistics are summarized in table 3. 97.04% of the total sample of producers located within 50 km of a rice miller implementing a marketing contract, and 56.5% are located within reach of a rice miller implementing a production contract. Contracted farms are generally located closer to rice millers proposing production contract (31.52 km) than other farms (56.3 km). Farmers who engage in spot transactions cultivate more horticultural products than other farmers. In 2010, there was no difference in terms of physical endowment. Households headed by a women contract less. Farms under production contracts also have more active members (4.11). Producer organizations that use marketing contracts have more members (32.2) than producer organizations without a marketing contract (23.5 members).

The average production cost per hectare is 517,195 FCFA. The main components of production costs are harvest and threshing (28.25%), hydraulic costs (16%), land preparation (15%) and fertilizers (15%). There is no difference in the perception of uncertainty about the quality of inputs between farms under different marketing modes, but farmers with a production contract perceive higher uncertainty concerning the credit issuing timeframe and inputs. Farmers who use spot transactions have slightly lower production costs (504,626 FCFA) than the farmers with a marketing contract (532,145 FCFA) or a production contract (528,439 FCFA).

[40] The quantity of paddy provided by producers is, given the price, equal to the value of the in-kind credit provided by the miller.

Farmer self-financing covers on average 46.7% of production costs. This rate is lower for contracted farmers than for the ones realizing spot transactions. Payments in paddy (for instance for threshing) contribute on average to 71.8% of self-financing. For in-cash payments, external financing is important. The share of production costs is covered by external financing at 43.9% for farmers carrying out spot transactions, at 63.9% for those with marketing contracts and at 63% for those with production contracts. The average uncertainty score for credit validation was 1.76, and reached 2.08 for producers with a marketing contract. 51.6% of farms who use spot transactions are members of a producer organization which had the right to a credit from CNCAS in the 2014 dry season, and the rate reaches 100% for farms under marketing contracts. Conversely, only 2.6% of farms with a production contract had the right to a credit from CNCAS.

A total of 32.1% of the paddy produced is self-consumed. This rate is lower in the case of contracted farms. Farmers involved in plural forms of governance sell around the two thirds of their paddy under contract and the remainder through spot transaction. Collective sales account for an average of 64% of paddy sold when considering all marketing modes. Individual sales account for slightly lower volumes under production contracts (31%) than under spot transactions (38.9%). All farmers consider that there are risks of low prices (3.72), of seasonal fluctuations (3.81) and of a decline in quality between harvest and sale (3.59).

Table 3 (1/2): Characteristics of rice producers

Descriptive variable	Total sample N=372	Spot transaction uniquely N=194		Marketing contract and spot transaction N=105			Production contract and spot transaction N=75		
	Mean	Mean	s.d.	Mean	s.d.	t-statistic[41]	Mean	s.d.	t-statistic[42]
Livelihoods									
Developed area (ha)	1.47	1.26	1.09	1.62	1.03	-2.75***	1.79	1.31	-3.35***
Number of active members	3.25	2.95	1.65	3.19	1.37	-1.25	4.11	1.87	-4.93***
Experience in rice growing (years)	17.84	17.05	10.45	18.49	7	-0.86	17.79	7.75	-0.21
Age of head of household (years)	48.83	48.25	11.33	50.65	10.6	-1.78**	47.77	10.02	0.32
Female head of household (%)	0.056	0.099	0.29	0.009	0.098	2.97***	0.013	0.11	2.41***
Ethnic group Wolof (%)	0.73	0.66	0.48	0.81	0.39	-2.81***	0.8	0.4	-2.31**
Horticulture (%)	0.56	0.61	0.49	0.5	0.5	1.7485**	0.51	0.5	1.53*
Livestock (%)	0.32	0.34	0.47	0.29	0.46	0.76	0.33	0.47	0.08
Trade (%)	0.29	0.28	0.44	0.29	0.46	-0.35	0.32	0.47	-0.71
Salaried (%)	0.23	0.23	0.42	0.25	0.44	-0.36	0.23	0.41	0.27
Value of non-land assets in 2010 (thousands FCFA)	1.545	1.665	2.438	1.461	2.783	0.64	1.354	1.791	1
Number of members in the producer organization	27.11	23.5	14.1	32.2	20.3	-4.72***	23.97	24.71	-0.18
Distance from the national road (km)	10.59	3.33	5.2	17.3	11.6	-14.21***	19.81	12.14	-15.5***
Distance from a rice miller offering a production contract (km)	44.34	56.3	27.1	32.6	14	8.36***	30	10.47	8.17***
Household income from the sale of rice (%)	0.69	0.725	0.261	0.616	0.254	3.49***	0.689	0.268	1.01
Producer organization that has the right to a credit from CNCAS (%)	0.481	0.516	0.501	1	0.44	-3.9***	0.026	0.16	8.27***
Production costs self-financed by the producer[43] (%)	0.467	0.561	0.239	0.361	0.099	8.19***	0.37	0.1	6.56***
Production costs financed by a credit from CNCAS (%)	0.321	0.286	0.31	0.613	0.11	-10.45***	0	0	7.96***
Production costs financed by a production contract (%)	0.11	0	0	0	0	0	0.54	0.12	-56.61***

[41] Compared with spot transaction group.

[42] Compared with spot transaction group.

[43] Opportunity costs are FCFA 40,000 per hectare for land rental, FCFA 500 for manpower per day during the season except for harvest, which it costs FCFA 1,500 per day. Transport of seed, fertilizer and herbicide is zero but transport of bags of paddy is FCFA 50 per bag. Seasonal workers are often given room and board, which costs FCFA 5,000 per month. The opportunity cost of in-paddy payment is FCFA 75 per kilogram. That is high since threshing represents around 10% of production.

Table 3 (2/2): Characteristics of rice producers

Descriptive variable	Total sample N=372	Spot transaction uniquely N=194		Marketing contract and spot transaction N=105			Production contract and spot transaction N=75		
	Mean	Mean	s.d.	Mean	s.d.	t-statistic[44]	Mean	s.d.	t-statistic[45]
Uncertainty (Likert scale from 1 to 4)									
Obtaining a credit from CNCAS	1.76	1.61	1.21	2.08	1.49	-3.02***	1.68	1.26	-0.42
Delay in obtaining credit and inputs	2.55	2.34	1.44	2.55	1.49	-1.21	3.06	1.33	-3.8***
Quality of inputs	1.73	1.86	1.36	1.26	0.84	4.12***	2.08	1.33	-1.19
Decline in quality of paddy	3.59	3.64	0.98	3.5	1.1	1.09	3.56	1.07	0.59
Variety consistency	2.49	2.69	1.47	2.04	1.42	3.68***	2.6	1.51	0.44
Identification of a purchaser	3.34	3.48	1.08	3.16	1.3	2.25**	3.25	1.28	1.45*
Purchaser may not pay	2.2	2.33	1.49	1.91	1.39	2.34***	2.28	1.49	0.24
Price fluctuations	3.81	3.8	0.76	3.9	0.52	-1.18	3.76	0.82	0.35
Price is low	3.68	3.71	0.88	3.66	0.86	0.53	3.65	0.85	0.51
Household rice self-sufficiency	3.8	3.72	0.88	3.8	0.75	-0.8	4	0	-2.77***
Uses of paddy									
Paddy self-consumed (% of quantity harvested)	0.321	0.379	0.142	0.239	0.189	7.23***	0.286	0.099	5.21***
Paddy sold by spot transaction (% of quantity sold)	0.674	1	0	0.338	0.139	66.12***	0.31	0.137	70.13***
Paddy sold by contract (% of quantity sold)	0.322	0	0	0.662	0.139	-66.12***	0.69	0.137	70.13***
Paddy individually sold by spot transaction (% of quantity sold)	0.359	0.389	0.413	0.338	0.139	1.23	0.31	0.137	1.61*
Paddy collectively sold by spot transaction (% of quantity sold)	0.318	0.611	0.413	0	0	15.14***	0	0	12.79***

[44] Compared with spot transaction group.
[45] Compared with spot transaction group.

Table 4 lists the results of the trivariate logit model which explains the drivers of plural forms of governance.

The farmer's financial capital is the key variable. The access of producer organizations to credit at the national bank strongly influences the likelihood of dual forms of governance. When a producer organization is granted access to credit at CNCAS, the odds of this producer combining a marketing contract and spot transactions increases 61.09 times compared to producers only involved in spot transactions and not having access to credit at CNCAS. On the contrary, access to CNCAS reduces the odds of combining a production contract and spot transactions compared to the same group. This means that when producers are excluded from the national bank through their producer organization, their odds of combining production contract and spot transactions increase 78.74 times compared to producers in the reference group (1/0.0127). Furthermore, an increase in the perception of uncertainty of access to credit also increases the odds of producers participating in contract, particularly in a production contract, for which the odds are then 8.67 times higher than the reference group. Another dimension of the farmer's financial capital is diversification. Livestock rearing reduces the odds of entering production and marketing contracts, and horticulture reduces the odds of taking out a marketing contract. Non-agricultural activities reduce the probability of participation in plural forms, particularly when the farmer is salaried.

Distance is also a strong driver of contract participation. An increase of one kilometer in the distance from a rice miller offering production contracts decreases the odds of implementing such a contract by 1.22 times, compared to producers who only use spot transactions. Conversely, the distance from the national road increases the odds of combining modes of governance.

The odds of having a production contract and using spot transactions are 6.44 times higher than the odds of producers only using spot transactions while the perception of uncertainty by producers with respect to the quality of the inputs increases. This tendency was not observed in the case of combination of a marketing contract and spot transactions because marketing contracts do not provide a different access to inputs.

Uncertainties concerning paddy transactions increase the likelihood of participation in both kinds of plural forms. According to the producers' strategy, a marketing contract enables better control of price fluctuations and identification of purchasers. Selling prices range between 112.5 FCFA/kg and 137.5 FCFA/kg with a marketing contract and between 83.35 FCFA/kg and 150 FCFA/kg for spot transactions. Production contracts ensure that the paddy quality does not deteriorate, because the miller comes quickly after harvesting to collect it. Production contracts also control uncertainty concerning outlets (as there is no need

to look for a purchaser), avoid the risk of no payment by the purchaser (since there is no payment, the miller providing the credit) and price instability (price ranges between 100 FCFA/kg and 112.5 FCFA/kg).

Nevertheless, certain forms of uncertainty reduce the odds of participating in plural forms. Perception of the risk of their paddy being rejected because of non-compliance with quality criteria decreases the odds of participating in marketing contract. A negative influence was also observed due to uncertainty about the level of price by producers under a production contract. In the 2014 dry season, the average purchasing price was 104 FCFA/kg for this contract whereas it was 123.3 FCFA/kg for spot transactions.

Table 4: Trivariate logit model of participation in plural forms of governance

Spot transaction uniquely as the base outcome	Marketing contract and spot transaction				Production contract and spot transaction			
Variables	Coef. (Std. Err)	Relative risk ratio	z	P>z	Coef. (Std. Err)	Relative risk ratio	z	P>z
Livelihoods								
Developed area (ha)	-0.04 (0.18)	.9607381	-0.22	0.828	.753741 .1986102	2.124934	3.80	0.000
Number of active members	-.0425901 .1704735	.9583041	-0.25	0.803	.3338732 .1818193	1.396366	1.84	0.066
Experience in rice growing (years)	-.0492742 .0246952	.9519201	-2.00	0.046	-.0893817 .0301218	.9144965	-2.97	0.003
Age of head of household (years)	.0311614 .0208858	1.031652	1.49	0.136	.0479619 .0254553	1.049131	1.88	0.060
Female head of household (1: Yes)	-4.238539 1.642976	.0144287	-2.58	0.010	-2.312686 1.180292	.098995	-1.96	0.050
Ethnic group Wolof (1: Yes)	.6229247 .4191183	1.864373	1.49	0.137	.7544396 .5286275	2.12642	1.43	0.154
Horticulture (1: Yes)	-1.698251 .3995017	.1830034	-4.25	0.000	-.5871836 .4544516	.5558907	-1.29	0.196
Livestock (1: Yes)	-1.219941 .4996878	.2952477	-2.44	0.015	-2.990875 .5285376	.0502434	-5.66	0.000
Trade (1: Yes)	1.163451 .4481253	3.20096	2.60	0.009	1.003043 .4989991	2.726566	2.01	0.044
Salaried (1: Yes)	2.17965 .4918203	8.843207	4.43	0.000	1.84266 .5687907	6.31331	3.24	0.001
Value of non-land assets in 2010 (in thousands FCFA)	3.92e-08 1.24e-07	1	0.32	0.753	8.70e-10 1.22e-07	1	0.01	0.994
Number of members in the producer organization	.0279161 .0115597	1.028309	2.41	0.016	-.0166683 .0110347	.9834698	-1.51	0.131
Distance from the national road (km)	.4033158 .0510763	1.496779	7.90	0.000	.4823847 .055945	1.619933	8.62	0.000
Distance from a rice miller offering a production contract (km)	-.0962002 .0128666	.9082822	-7.48	0.000	-.1997654 .021798	.8189228	-9.16	0.000
Producer organization that has the right to a credit from CNCAS (1: Yes)	4.112331 .5849238	61.08894	7.03	0.000	-4.364685 .9006037	.0127187	-4.85	0.000
Uncertainty								
Obtaining a credit from CNCAS	1.22267 .1919354	3.396242	6.37	0.000	2.160004 .2649772	8.671175	8.15	0.000
Delay in obtaining credit and inputs	.1755544 .184167	1.191907	0.95	0.340	1.140427 .2120485	3.128102	5.38	0.000
Quality of inputs	.2958806 .2295605	1.34431	1.29	0.197	1.862725 .2717398	6.441263	6.85	0.000
Decline in quality of paddy	-.0469919 .407269	.9540952	-0.12	0.908	1.187372 .4704127	3.278453	2.52	0.012
Variety consistency	-.758837 .165188	.4682106	-4.59	0.000	.3384595 .2144456	1.402785	1.58	0.114
Identification of a purchaser	1.087679 .2752322	2.967378	3.95	0.000	.5613631 .3351737	1.75306	1.67	0.094
Purchaser may not pay	.2114966 .1626595	1.235526	1.30	0.194	1.012536 .2155912	2.752573	4.70	0.000
Price fluctuations	1.166688 .3671575	3.21134	3.18	0.001	2.225442 .5604927	9.257577	3.97	0.000
Price is low	-.743314 .4606034	.4755354	-1.61	0.107	-4.645363 .6726964	.096060	-6.91	0.000
Household rice self-sufficiency	-.3103543 .2145799	.7331872	-1.45	0.148	4.243533 117.8945	69.65352	0.04	0.971

_cons	-7.936125	1.812602	.0003576	-4.38	0.000	-27.5543	471.5827	1.08e-12	-0.06	0.953
N = 372										
Chi2(50)=1960.65										
Prob > chi2 = 0,0000										
Log likelihood = -338.88155										
Pseudo R2=0.7431										
Hausman tests of Independence of Irrelevant Alternatives assumption (N=372). 1,000 for spot transaction.	0.382					0.856				
Rate of correct prediction (Spot transaction = 0.762)	0.943					0.931				

5. Discussion

Agricultural financing has played a major role in the development of the rice VC in the SRV. The national bank provides producer organizations with loans to grow rice. In order to reimburse the loan, the members of the producer organizations undertake collective sales through spot transactions to small-scale processors. In parallel, they engage in individual spot transactions that can be adapted to the household's food and cash needs (Colen et al., 2013). Nevertheless, the national agricultural bank in Senegal has difficulty getting its loans reimbursed.

There are imperfections on the market of credit in developing countries that yield high transaction costs, especially for banks with wide geographical distribution that lend to small-scale producers (Hoff and Stiglitz, 1993). Imperfect information generates a principal-agent problem that constrains screening and monitoring by the banks. Furthermore, the legal institutions are weak in enforcing repayment. For these reasons, commercial banks infrequently lend to small-scale producers, and numerous debt forgiveness programs have been implemented by governments for producers who borrow from national banks. The existence of informal institutions, such as interlinked transactions or *tontines*, is explained by their capacity to reduce transaction costs resulting from imperfect information and enforcement failure (Besley, 1994). Informal lenders have competitive advantages over formal bank thanks to their proximity with borrowers. Nevertheless, they specialize in loans to certain types of borrowers because their access to information is limited to a geographical or social scope. For this reason, the credit market is often segmented with a monopolistic structures on the segments (Varghese, 2005; Hoff and Stiglitz, 1993). The informal lenders practice high interest rates because of these high transaction costs and the monopolistic structure of these segments (Long, 1968).

Contracts in the SRV are VC financing devices implemented to reduce transaction costs. Since 1987, the national agricultural bank supports rice production by supplying credit to farmers. Its interest rate is the lowest of the area because it is subsidized by the government. Recent investments from rice millers in industrial techniques require large volumes of paddy that comply with precise quality criteria. Policies and private initiatives supported the use of contracts that link credit (in kind or in cash) and paddy. Marketing contracts were developed to enforce reimbursement to the national bank. It is a formal arrangement rooted in the law and enforcement should be the responsibility of the interprofessional association. Producers using it must have access to credit at the national bank. The production contract is a buyer-driven VC financing device (Jessop et al., 2012) used by rice millers to secure their supply of paddy and by producers excluded from credit with the national bank to fund rice growing. It is similar to informal credit arrangements because screening, monitoring and enforcement are not rooted in the law

but in geographical and relational proximity. The difference from interlinked transactions is that the production contract is written, with explicit accountability, and includes complex quality indicators. Interest and insurance rates are high because transaction costs are still high and the structure of this segment is oligopolistic.

Participation in forms of governance is linked to producer financial livelihoods, particularly the indebtedness of producer organizations with the national bank (see Table 5, based on multiple component analysis for non-contracted farmers in figure 2 in appendix 1). Producers who are sufficiently diversified to be able to self-fund rice growing do not sell their paddy under a contract because they do not have to repay any credit. But most of the farms are specialized and do rely on external funding. They use credit from the national agricultural bank if they are members of non-excluded producer organizations. In the latter case, the type of sales undertaken to reimburse the credit from the national bank is influenced by the perception of uncertainty by the group of producers. As a result, uncertainty drives towards plural forms of governance, as was observed in previous studies (Bigio Schnaider, 2016; Ménard et al., 2014; Ménard, 2013). Uncertainty particularly concerns access to credit for the following season. Uncertainty over price stability and the identifity of a purchaser also drives producers towards a marketing contract to reimburse loans (Poole et al., 1998). Nevertheless, the risk of rejection of paddy for non-compliance with quality criteria reduces the probability of implementing plural governance, in agreement with the results reported by Mujawamariya et al. (2013). A production contract is often the last recourse to fund rice growing for farmers who are members of producer organizations that are excluded from credit with the national agricultural bank. When these farmers are located within the collection radius of millers offering production contracts, they use such a contract to fund rice growing and engage in spot transactions to cover other needs. Indeed, producers expect a production contract to be less remunerative than spot transactions. Masuka (2012) had also found that higher prices in spot transactions than in contract was an incentive to implement plural forms. The second order driver of participation in production contract is uncertainty over loss of paddy quality, outlets, risk of no payment and price instability. Finally, the last category of producers is specialized in rice growing, excluded from CNCAS credit and located beyond the reach of rice millers offering production contracts. That category has no other source of credit and was thus unable to grow rice in dry season 2014.

Table 5: Typology of producers based on their mode(s) of financing and sales

	Single governance		Plural governance		Do not grow rice
Governance	Spot transaction		Production contract and spot transaction	Marketing contract and spot transaction	No sale
Farm diversification	Yes	No	No	No	No
Authorization to get a credit from CNCAS	No	Yes	No	Yes	No
Distance from a miller offering production contracts	<50 km	All distances	<50 km	All distances	>50 km
Uncertainty on credit transaction	No	No	Yes	Yes	Yes

6. Conclusion

The modernization of certain domestic food chains in Asia and Africa is an opportunity to improve the income of small-scale producers. The question of the drivers of small-scale producer participation in contract farming has therefore important implications for development. But existing literature considers that producers are either included in traditional VCs with spot transactions or in modern VCs with contract farming. This paper addresses the issue of plural forms of governance. It analyzes the participation of small rice growers in contract farming in Senegal using a conceptual framework that takes into consideration the influences of livelihoods and uncertainty on the plurality of governance. The hypothesis, tested with a multimodal logit model, is that livelihoods and uncertainty drive plural forms of governance.

The development of the rice VC in Senegal is supported by the national agricultural bank which supplies credit to farmers. When funded by the bank, farmers combine two types of spot transactions: collective sales to repay their loan and individual sales to cover household's needs. But information imperfections and enforcement failure lead to low rates of reimbursement and the bank has followed several recovey plans. Policies set up marketing contracts to secure the reimbursement of credit with the national bank in addition to secure miller supplies. Moreover, some rice millers provide credit to producers excluded from this bank through production contracts, in order to secure their supplies of paddy.

Producers participate in plural forms to secure agricultural financing. The access of producer organizations to credit with the national agricultural bank in particular influences the likelihood of dual forms of governance. Producers granted such a credit are more likely to participate in marketing contracts, especially when they perceive high uncertainty over access to credit, outlets and price fluctuations. By contrast, producers excluded from credit at the national bank are more likely to

participate in production contracts. Marketing strategies are different among farmers because the financial capital of farms is different. The segmentation of the credit market is linked to the indebtedness of producers to the national agricultural bank.

The marketing price under production contracts is lower than that of spot transactions. Further research should address the impacts of contracts on producer incomes and food security. Furthermore, production contracts and vertical integration linked with large-scale investments could affect not only agricultural practices, but also the access to land of small producers. Detailed data and analysis is required.

TRANSITION 2: IMPACT ESTIMATION STRATEGY

Contracts in domestic grain chains

The literature about the effects of contract farming on small-scale producers mostly addresses two issues. The first one is the inclusion of producers. The contribution of the previous chapter is to show that, in a context of segmentation of the credit market, the financial livelihood of the farm is the main driver of participation in contracts. The second issue addressed is the impacts of contracts. The literature highlitghs that contracts in GVCs of high-value products commonly have positive effects on farmer incomes (Reardon et al., 2009). But there are fewer studies about the impacts of contracts in domestic food chains. It seems that contracts are less likely to appear in domestic grain chains (Swinnen et al., 2010). Nevertheless, recent research documents positive impacts on producer incomes in the context of the rice VC in Benin (Maertens and Vande Velde, 2017). The next chapter contributes to this literature, by documenting in a domestic grain chain the impacts of marketing and production contracts on producer income and food security.

Treated and control groups

A strand of literature assesses the impacts of contract farming with quasi-experimental methods. These methods aim at correcting the selection bias by comparing producers with identical characteristics except for participation. The difference in performance is attributed to the difference in participation. The non-contracted group is called the control group. It is made up of producers facing challenges in obtaining credit, inputs and outputs markets. These producers use extensive agricultural practices and market low quality products on low value markets through spot transactions. Contracted farmers have similar characteristics (for instance the number of members, the experience in agriculture). The difference is that contracts provide them with credit, improved inputs and outlets, which increases their income.

However, the previous chapter highlights that in the case of the rice VC in Senegal, the producers engaged in spot transactions (in the control group) are different in terms of access to credit from the national agricultural bank. The use of a homogeneous control group without distinction of producers according to their credit access would hide the homogeneity of the impacts of contract. Indeed, previous studies show that being debt-free at CNCAS was a main driver in the use of credit, and that the

use of credit has a positive impact on the demand for agricultural inputs, resulting in an increase in the average income (Fall, 2006).[46] For this reason, the impact evaluation strategy in the following chapter uses different control groups in order to highlight the varying impacts of contract farming in relation with producer access to credit (Table 1). Producers engaging in marketing contracts (which implies the use of credit obtained at the national bank) are compared with producers selling through spot transactions and using the credit. Producers with a production contract (and who do not use bank credit) are compared with two groups of producers. The first one is made up of producers who had no CNCAS credit, who did not grow rice and therefore who did not sell any paddy. In that case, I consider that the treated and control groups have no access to credit at the national bank, and that the production contract is the only opportunity to fund rice growing. The second control group includes producers who obtained credit at the national bank and marketed paddy through spot transactions.

Table 1: Treated and control groups for impact evaluation

Treated group	Marketing contract (with credit from the national bank)	Production contract (without credit from the national bank)	Production contract (without credit from the national bank)
Control group	Spot transaction (with credit from the national bank)	Producers who had no CNCAS credit and did not grow rice (no selling)	Spot transaction (with credit from the national bank)

Instrumental variable and propensity score matching methods

Experimental methods are based on randomized assignment to the treatment group. They best reduce selection bias but I could not use them because of time and financial resource constraints. Furthermore, they generate empirical issues such as risk of "non-compliance" of producers with their randomized assignment, and ethical issues since inequalities may be generated by the research protocol. The best quasi-experimental methods to reduce bias are the difference in difference and the instrumental variable methods (Barrett et al., 2012). The first one also relies on longitudinal survey (Khandker et al., 2009). I consequently use an Instrumental Variable model, which correct endogeneity including unobserved characteristics and self-selection. The difficulty of the method is to identify a truly exogenous instrument highly correlated with participation.[47] I could have used a Heckman selection

[46] Nevertheless, delays in getting the credit issued generate varying impacts on farmer incomes through increase in technical efficiency (Fall, 2006). The richest farmers own enough liquidity to anticipate purchasing of inputs. The poorest producers do not have that opportunity, and use fewer inputs than recommended. The positive impact of credit on producer incomes (+23%) therefore hides negative effects for a part of the poorest producers.

[47] Regression Discontinuity is a specific case of instrumental variable for which the instrument is an exogenous observable characteristic which separates participants and non-participants at a specific threshold. Difficulties are

model for a sub-sample of the data collected (producers who did not grow rice because of no way of getting funds) but then the comparison of results with other models would have been difficult because of different hypotheses. I also use propensity score models. This type of model is based on the strong ignorability hypothesis (Heckman et al., 1999), which states that there is no omitted variable and sufficient common support. I use it to check the robustness of the instrumental variable model (Barrett et al., 2012) and because it proposes a visual check for similarities of observations. Both methods are described in the next chapter. Table 2 synthesizes the impact evaluation methods.

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to identify a variable meeting this criteria, and participants may lie about this characteristic (Barrett et al., 2012). Endogenous Switching Regression models focus on self-selection of producers. It would have been appropriate but also would have oriented the paper towards the analysis of producer self-selection, which is already done in the previous chapter.

Table 2 (1/2): Impact evaluation methods

Methods		Rationale	Strengths	Weaknesses
Experimental methods	Randomization	Producers are randomly assigned to participate in contract farming.	• The randomized assignment is completely exogenous to observables and unobservable characteristics which eliminates selection bias.	• Compliance of contract actors to the research protocol • Expensive and time consuming • External validity • Research ethics
Quasi and non experimental methods	Ordinary Least Square	Inclusion of a dummy treatment variable in an Ordinary Least Square model regressing exogenous variables	• Ease of implementation	• Does not correct for sample selection bias
	Instrumental Variable	Used to correct for endogeneity. The instrument isolates a part of the treatment variable which is independent of unobserved characteristics affecting the outcome in order to generate an unbiased estimate of the treatment.	• Correct for endogeneity • Controls for selection on unobserved characteristics varying overtime • Relaxes the assumptions that the conditional mean of error is equal to zero and that regressors are uncorrelated • Local average treatment effect model corrects for self-selection	• Difficulty to find an exogenous instrument highly correlated with participation • Deals with endogeneity but not sample selection • If the treatment effect is inconstant within the population, the model estimates only the local average treatment effect • Results of local average treatment effect are asymptotically not robust
	Regression discountinuity	Use as an instrument an exogenous observable characteristic which separates participants and non-participants at a specific threshold.	• Ease of instrument identification • Correction of endogeneity	• Results of local average treatment effect are asymptotically not robust • The use of a threshold may reduce the number of observations usable for the comparison • Producers may lie about the instrumental characteristic
	Heckman selection model	Used for truncation. It defines a participation model and introduces the inverse mill ratio in the outcome equation to correct for self-selection	• Manages self-selection	• Relies on the assumption of joint normality of the errors • Only for truncated sample problem

Adapted from Khandker et al. (2009)

Table 2 (2/2): Impact evaluation methods

Methods		Rationale	Strength	Weaknesses
Quasi- and non-experimental methods	Propensity Score Matching	Participants are matched with non-participants on the basis of observable characteristics	• Control for observable characteristics • Does not require baseline survey • Fewer hypotheses on the error distribution	• Certain variables may be omitted • Common support area may be restricted • Spillover effects may exist
	Difference in Difference	Defines a baseline of the two groups before the treatment and matches them after the treatment based on their probability of participation	• Control for observable characteristics • Control for unobservable characteristics which are time invariant • Fewer hypothesis on the error distribution	• Does not control gor unobservable characteristics which vary overtime • Risks of changes in the context of one group (and not of the other) • Need for a partnership with the contracting firm • Producers may alternate participation and non-participation in contract farming

Adapted from Khandker et al. (2009)

CHAPTER 4: THE IMPACTS OF CONTRACT FARMING IN DOMESTIC GRAIN CHAINS ON FARMER INCOMES AND FOOD SECURITY—EVIDENCE FROM SENEGAL

A first version of this chapter was presented at the 149th Seminar of the European Association of Agricultural Economists:

Soullier, G. and Moustier, P. (2016). *Do contracts increase farmers' incomes and food security? Evidence from the rice value chain in Senegal*. 149th seminar of the European Association of Agricultural Economists, October 27-28, 2016. Rennes [online]. Available from: http://ageconsearch.umn.edu/record/244790/files/Soullier_Moustier_149EAAE_Rennes.pdf [Accessed 28 November 2016].

The revised version is under review at Food Policy.

1. Introduction

Contract farming is an intermediary form of vertical coordination that has been expanding in the private sector since the 1960s in response to the demand for high-quality products (Swinnen and Maertens, 2007). It is likely to appear when uncertainty and asset specificity are high, such as in the trade of products that are perishable, difficult to store, to transport and likely to be of heterogeneous quality (Minot and Sawyer, 2016). Since the 1980s, this institutional innovation has been increasingly used in Africa where agricultural and inputs markets often fail (Grosh, 1994). Contract farming in Africa mainly concerns tropical, horticultural and animal products produced by small-scale farmers and exported to northern markets (Swinnen and Maertens, 2007).

The scientific literature over the last 15 years mainly reports on the positive impacts of contract farming on family farms. Contractors support producers in improving the quality of their products through access to improved inputs and technical advisory services (Jaffee et al., 2011; Reardon et al., 2009; Eaton and Shepherd, 2001). Such contracts increase yields, farm gate prices and incomes (Maertens and Vande Velde, 2017; Mishra et al., 2016; Trifković, 2016; Girma and Gardebroek, 2015; Wang et al., 2014; Saenger et al., 2013; Bellemare, 2012; Rao and Qaim, 2011; Bolwig et al., 2009; Maertens and Swinnen, 2009; Minten et al., 2009; Miyata et al., 2009; Leung et al., 2008; Simmons et al., 2005; Warning and Key, 2002).

Contract farming is widely documented in export value chains (VC) for high-value products (Minot and Sawyer, 2016), but little has been published about the impact of contract farming in domestic grain chains. Indeed, such contractual arrangements in these VCs are less likely because the demand for high-quality products is limited, which prevents the appearance of a premium. Furthermore, the low perishability of grain facilitates side selling (Swinnen et al., 2010). Nevertheless, contract farming recently appeared in certain domestic grain chains in sub-Saharan Africa. Factor favoring such contracts are the demand for high-quality cereals (Demont and Ndour, 2015), state policies implemented after the world food price crisis in order to modernize domestic food chains (MA, 2009) and support from international organizations for farmer organizations (Maertens and Vande Velde, 2017). As a result, contract farming is increasingly implemented by private companies in Madagascar (Bellemare, 2012), Benin (Maertens and Vande Velde, 2017) and Senegal. But questions remain about the capacity of chains that target high-quality domestic markets to create an increase in added value that benefits producers.

Furthermore, in the case of staple chains, analysis of the impacts of contract farming needs to be extended to food security. Indeed, the implementation of contract farming in grain chains could create

competition between sales and domestic consumption by farming families. Few studies have questioned the impact pathways between contract farming and farmer food security. Minten et al. (2009) found that contract farming shortened lean periods. Bellemare and Novak (2017) found a positive impact thanks to an increase in income. More information is required about these impact pathways.

Finally, the literature considers that producers either market their product in traditional VCs through spot transactions or in modern VCs through contracts. But producers sometimes combine contracts and spot transactions because the two types of marketing fulfill distinct functions. For instance, contract farming provides access to improved inputs and profitable markets, while spot transactions ensure rapid payment (Masuka, 2012), access to credit for unexpected expenses and outlets for products rejected by contractors (Mujawamariya et al., 2013). Such a combination of marketing modes is sometimes cited in the literature, but without documenting its impacts on farmer incomes (Rao and Qaim, 2011; Da Silva, 2005; Gow and Swinnen, 1998, 2001).

The objective of this paper is to assess the impacts of two types of contract on farmer incomes and food security in a domestic grain chain. The hypothesis is that contracts improve farmer incomes through access to credit, improved inputs and technical advice, thereby increasing yields and improving quality (Reardon et al., 2009). Contracts also improve farmer food security by increasing their incomes (Bellemare and Novak, 2017). The paper helps fill the knowledge gap on the impacts of contract farming in domestic grain chains. It breaks down the impacts of contract farming and of the combination of two marketing modes on farmer incomes. It highlights different pathways from contract farming to food security. It also helps understand the conditions under which contract farming may fail to generate higher income for producers.

The rice VC in the Senegal River valley (SRV) provides empirical insight into the impact of contract farming in sub-Saharan Africa. We use a database of 594 observations specifically built for this study. We distinguish the different ways the producers sell their rice and identify possible combinations. We use instrumental variables models and propensity score matching models to correct selection bias.

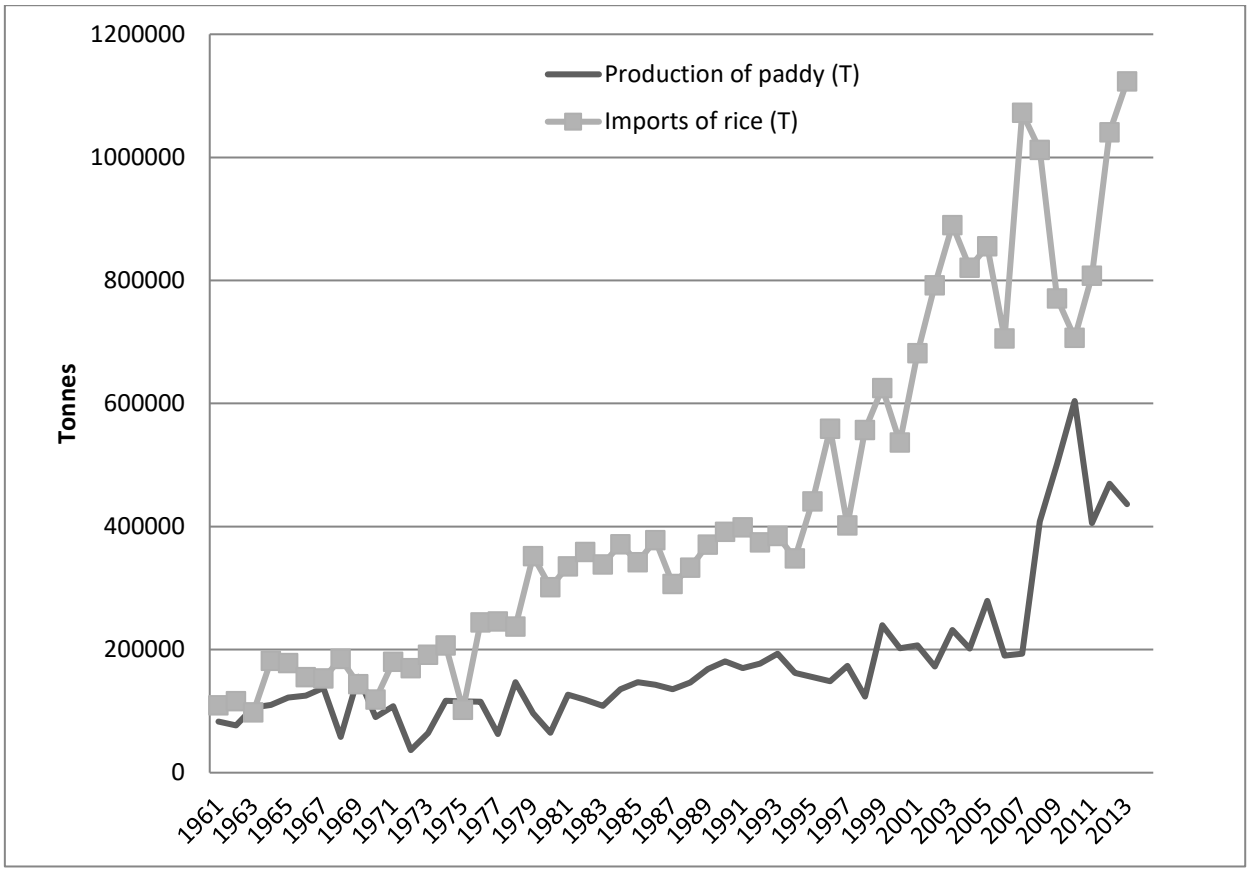
Section 2 presents the empirical background of contract farming in the Senegalese rice VC. Section 3 describes the method. Section 4 presents the results. Section 5 discusses the nature of contracts and section 6 concludes.

2. Background

2.1. Production and consumption in Senegal

Imports of rice in Senegal increased by 2.2% per year between 1960 and 2011 (Figure 1) and accounted for 80% of domestic consumption between 2001 and 2010 (Seck et al., 2013). The particularity of Senegal among West African countries is that 98% of rice consumption refers to broken rice, a byproduct of milling (Hathie and Ndiaye, 2015). Therefore, domestic production faces competition from cheap imports. However, the shift in demand towards higher-quality products also concerns broken rice (Demont et al., 2013).

Figure 1: Rice imports and production in Senegal (data from FAOSTAT)[48]



[48] Note: the paddy to milled rice conversion factor is 0.67.

2.2. Agricultural policies and modernization of the rice value chain

Since independence in 1964, several programs implemented by the government and international organizations aimed at developing the rice VC in Senegal (Fall, 2006). Following the world price crisis, the inter-ministerial council created a new national program for rice self-sufficiency (MA, 2009) with the support of the Coalition for African Rice Development (CARD, 2008). This program aimed at expanding land under rice from 55,000 ha in 2008 to 175,580 ha in 2012 in order to increase national production from 535,000 tons of paddy to 1,500,000 tons. These goals were subsequently postponed to 2018 (MA, 2014). The main target area is the SRV which accounted for 80% of domestic rice production in 2014 (USDA, 2015). The two main agencies implementing these policies are the national agricultural bank (French acronym CNCAS) and the national company that supports irrigated agriculture in the SRV (French acronym SAED).

Agricultural financing has been a major tool used by the government to support rice growing since 1964. The CNCAS is the main source of credit in the SRV because diversification and other sources of credit are limited. In 2005, diversification accounted for between 20% and 30% of rice production costs and only 2% of farms took out a loan from a small-scale processor (Fall, 2006). Access to credit at CNCAS by small-scale producers goes through producer organizations. These organizations obtain a loan if they have reimbursed previous loans, if they crop irrigated land, and if their technical production specifications are validated by SAED. Producer organizations also enable the collective purchase of seed, fertilizers and herbicides. Producer organizations with a loan from CNCAS buy fertilizer with a 50% subsidy and the rate of interest on the loan is subsidized, which reduces it from 12.5% to 7.5%. Finally, producer organizations can sell the paddy to reimburse the bank loan. Yet CNCAS has had difficulty being reimbursed since it was created. The government of Senegal has intervened four times since 1991 to implement recovery plans. The last intervention costed 13.6 billion FCFA.

In the SRV, rice is grown in two seasons on irrigated land. Intensive agricultural practices include the use of certified seed, synthetic fertilizers and herbicides, mechanization for threshing, land preparation and harvest. Support for intensification provided by SAED since 1973 enabled producers to reach yields of 6.7 t/ha in the dry season and 5.3 in the wet season in 2014 (our data).

A total of 45,000 family farmers are located in the SRV (Gergely and Baris, 2009). In 2010, 39.5% of them were considered to be living on less than $1.9 a day (ANSD, 2010) and 16.1% were affected by food insecurity, measured by the frequency of consumption of different food groups consumed by a household during the seven days preceding the survey (WFP, 2014).

2.3. Modernization of the rice value chain

The VC that we characterize as *traditional,* in which producers market their paddy through spot transactions, has been operating since the 1970s. Small-scale processors use mills to husk the rice (Fall, 2006). The quality of rice is low since it contains impurities and is not sorted by grade, in addition to having a moisture content inappropriate for cooking. The small-scale processors purchase the paddy from farmers and from producer organizations through spot transactions including relational proximity. They visually check the quality of paddy for impurities. Their simple husking technique does not require complex indicators of quality in transactions. Producer organizations that benefit from a credit from CNCAS market their paddy to the small-scale processors and repay the loan to the bank with the money they get for the sale. The selling price of paddy through spot transactions varies considerably over the season. This traditional VC concerned 87% of paddy produced in 2014 in the SRV.

Since 2009, eight firms have used their profits and sometimes subsidies from development agencies to invest in modern husking techniques. These units can process up to three tons of paddy per hour, and perform other functions including drying, cleaning and sorting. These processors are located in Dagana Department, which accounted for 93.5% of the 26,019 ha cropped by small-scale farmers in the 2014 dry season in the SRV. Their modern husking techniques need to be combined with specific paddy quality criteria to yield broken and whole-grain rice with no impurities and with the right moisture content. They also require sufficient volumes of paddy to cover their high depreciation costs. In 2014, each rice miller processed between 2,000 tons and 13,000 tons of paddy out of a total of 45,000 tons. These quantities were limited by the quantities of paddy that rice millers were able to collect.

2.4. Contracts

With the program “Feed the Future”, USAID supports SAED and CNCAS in developing the rice VC. Marketing contracts were introduced in 2011 to secure the quantity and quality of the supplies received by the millers and to guarantee reimbursement of the credit issued by CNCAS. Marketing contracts are part of the credit system described above. The paddy supplied by the producer organizations reimburses the credit. With the contract, millers pay the money directly into the producer organization’s bank account, which repays the bank. The bank promotes the use of contracts by both producer organizations and millers. The producer organizations who participate must obtain credit from CNCAS, be located within 50 kilometers of the miller and be able to supply at least two tons of paddy. The millers who use marketing contracts are located close to the national road that crosses the department and serve all of Dagana Department. All marketing contracts use the template negotiated within the interprofessionnal association. It includes information about the quantity, quality and price of paddy. At the beginning of

the season, a suggested price is negotiated within the interprofessional organization and is taken into consideration in the marketing contracts. In the 2014 dry season, the suggested price was 125 FCFA/kg. The contract price also accounts for the moisture content (which must be between 12% and 14%), the consistency of the variety, and the proportion of impurities (which must be less than 1%). If the quality criteria are not met, millers can refuse the paddy or reduce the price. In the 2014 dry season, marketing contracts were used to sell 15,000 tons of paddy by 98 producer organizations including 2,000 small-scale producers growing rice on a total of 4,000 ha.

Production contracts were created in 2010 by rice millers to ensure the quantity and quality of their supplies. Both rice millers and farmers can initiate such a contract. Farmers must grow at least 2.5 ha of irrigated rice or be part of a producer organization, in addition to being located within the collection radius of 50 kilometers from a miller. Millers who use production contracts are concentrated in the north of the department and their collection radius does not cover the whole territory. Indebtedness to CNCAS is a major driver of participation in production contracts by producers because other sources of credit are limited. In the 2014 dry season, only 2.6% of producers who had a production contract belonged to a producer organization that had the right to apply for a CNCAS loan. The in-kind contract is written and its content can be adapted to the needs of producers: seed, fertilizers, herbicides and/or mechanized services. The miller may also provide technical support and have power of decision over the technical itinerary. The quality of paddy required is the same as under a marketing contract. The price per kilogram is negotiated before harvest and farmers reported having little power to influence it because they have no alternative way to fund rice growing in the following season. The average purchase price during the 2014 dry season was 104 FCFA per kilogram. None of the producer organizations who had a production contract in the 2014 dry season supplied more than the quantity of paddy equal to the value of the credit. If a contract is breached, a new contract is usually established with closer supervision by the rice miller. In 2014, production contracts were used by 71 producer organizations who cultivated 3,500 ha and included 1,500 producers. Production contracts concerned 5.6% of the production of paddy in the SRV.

2.5. Combined marketing modes

Small-scale farmers combine two types of sales (Colen et al., 2013). The first type is made by the producer organization to reimburse the loan, through spot transactions, a marketing contract or a production contract. The price determines the volumes that producers must supply to reimburse the amount of the loan. The second type of sale is individual spot transactions, which enable flexibility and quick cash payment.

3. Methods and data

3.1. Models to correct selection bias

Selection bias arises when participation in contract farming is not randomly decided due to purposive targeting of firms and self-selection of beneficiaries (Barrett et al., 2012). The impact of participation in a contract is:

$$\mathrm{E[Y(1)/D = 1]} - \mathrm{E[Y(0)/D = 1]} + \mathrm{E[Y(0)/D = 1]} - \mathrm{E[Y(0)/D = 0]} \qquad (1)$$

where Y is the outcome and D the treatment variable with D=1 for participation in a contract and D=0 for participation in a spot transaction. The purpose of impact evaluation is to minimize the term $\mathrm{E[Y(0)/D = 1]} - \mathrm{E[Y(0)/D = 0]}$ in (1) which represents the selection bias (Caliendo and Kopeinig, 2008).

The combination of parametric and non-parametric models strengthens the robustness of results because they rely on different hypotheses (Kleemann et al., 2014; Barrett et al., 2012). We first use an instrumental variable (IV) model that corrects for endogeneity such as selection on unobserved characteristics. IV models relax the assumptions that the conditional mean of error is equal to zero and that regressors are uncorrelated (Khandker et al., 2009). The strength of an IV model depends on the identification of instruments closely correlated with the treatment variable but not with the outcome. We also use propensity score matching models (PSM) (Rubin, 1974) to complement the IV strategy. PSM generates results close to randomized estimates when there is no significant omitted variable (Khandker et al., 2009). The robustness of the results to this strong hypothesis can be tested (Rosenbaum, 2005).

In the case of public interventions aiming at reducing poverty, the average treatment effect on the treated (ATT) should be estimated (Guo and Fraser, 2014; Heckman, 2005). It measures the difference between the average outcome of treated observations and the average outcome of these observations if they were not treated:

$$ATT = E[Y(1)/D = 1] - E[Y(0)/D = 1) \qquad (2)$$

The IV model makes it possible to correct endogeneity. In our study, the risk of measurement error is low since producers have no interest in misreporting their participation; they have the same ability to remember data; and we cross-checked marketing mode, price and quantity data with the leaders of the producer organizations and with the agricultural advisors. But omitted variables and reverse causality are possible in contract farming (Bellemare, 2012). The use of an instrument generates an unbiased

estimate of the treatment by isolating the part of the treatment variable that is independent of the unobserved characteristics that affect the outcome.

The ordinary least square regression includes covariates as a control function to correct for selection bias:

$$Y_i = \alpha_1 + \beta_1 . X_i + \gamma_1 . D_i + \varepsilon_i \quad (3)$$

where i is the individual, α is the constant, β is the coefficient associated with the individual and contextual characteristics of producers (X_i), γ is the coefficient associated with this treatment variable and ε is the error term. The suspected endogenous variable is the participation dummy D_i. Endogeneity is corrected using a two-stage least square model in which Z_i is the vector of IVs for D_i. In the following equation, the ATT is the estimation of the coefficient γ.

$$Y_i = \alpha_2 + \beta_2 . X_i + \gamma_2 . Z_i + \mu_i \quad (4)$$

The challenge when using IV models is to identify instruments that meet the exclusion restriction condition (Wooldridge, 2010). Such instruments are described below. We provide the Kleibergen-Paap statistic for under-identification of instruments, which tests if excluded instruments are not correlated with the endogenous regressor. We also provide the Cragg-Donald Wald statistic for weak identification which tests if the instruments are sufficiently correlated with the endogenous regressor.

We also use the PSM model to correct selection bias. The propensity score of participation PS_i of an individual is calculated using a probit density function.

$$PS_i = Pr(D=1/X_i) \quad (5)$$

Control and treated individuals are matched by minimizing the difference between the probability of their participation (Rubin, 1974): $\min_{j \epsilon C} \| PS_i - PS_j \|$, where *j* is the observation from the control group matched with individual *i* from the treated group. The nearest neighbor matching algorithm is used to compare one treated observation with the closest ones in terms of probability of participation (Caliendo and Kopeinig, 2008). We keep the five closest observations, and matching is achieved with replacement. This algorithm reduces the estimation bias (Dehejia and Wahba, 2002). For both treatments, we fix the caliper at 20% of the variance of the propensity score, which minimizes the mean of the square of the error term (Austin, 2011).

PSM relies on the strong ignorability hypothesis (Heckman et al., 1999). First, the common support hypothesis means that there are sufficient observations in the treated and control groups with the same

probability of participation (Caliendo and Kopeinig, 2008). Second, conditional independence means no variable is omitted (Imbens, 2004). We test the sensitivity of the results yielded by PSM with the Rosenbaum bounds test (Rosenbaum, 2005; Rosenbaum and Rubin, 1983), which tests the robustness of results to the existence of an omitted variable which would imply changes in propensity scores.

3.2. Groups compared

The treated and control groups are detailed in table 1. We compare producers who use a marketing contract with producers who use a CNCAS credit and sell their rice through spot transactions. We compare producers who have a production contract with two groups of producers in order to highlight the heterogeneous impacts of production contract. We first compare producers who had a production contract with producers who were excluded from CNCAS and for this reason did not grow rice in dry season 2014. These producers are nevertheless considered as rice growers because rice was their main livelihood before they were excluded from the bank. We then compare producers with a production contract with producers who use a CNCAS credit and sell their paddy through spot transactions. Since there is variation in control groups, we use one model per treatment, which implies that treatment is a binary variable.

Table 1: Treated and control groups

Treatments	Marketing contract	Production contract	
Number of treated observations	130	155	155
Control group	Producers who used a CNCAS credit and sold through spot transactions	Producers who had no CNCAS credit and did not grow rice	Producers who used a CNCAS credit and sold through spot transactions
Number of control observations	141	44	141

3.3. Sampling:

The study area is Dagana Department, the core rice producing area in Senegal and the only place where contracts were found in 2014. We conducted a cross-sectional survey. Sampling was carried out in three steps. First, hydraulic unions grouping small-scale producers were selected. Second, we randomly selected producers organizations after stratification according to the types of marketing, i.e. spot transactions, marketing contracts and production contracts. Stratification was done with help of agricultural advisors using exhaustive SAED databases and information from rice millers. Contract farmers were oversampled: the ratio of both the treated sample to the treated population was six times

higher than the ratio of the control sample to the control population. We corrected for oversampling of treated observations during data processing. The 90 randomly selected producer organizations represent the 1,105 producer organizations that grew rice on 26,019 hectares in the 2014 dry season. Third, among each producer organization, we randomly selected six producers. When one producer could not be found, we selected the next one on the list. Data were collected in May 2015. The data concerned the previous dry and wet seasons and were collected before the harvest of the following dry season, to reduce the chance of confusion, and to better detect food insecurity. The database includes 594 observations: 265 producers who engaged in spot transactions, 130 with marketing contracts, 155 with production contracts and 44 producers who did not grow rice in the 2014 dry season.

3.4. Variables and indicators

The same broad questionnaire was used for all respondents. It queried the organization of production, financing, processing, marketing, household characteristics, sources of income, assets, uses of paddy and food security.

The survey was carried out in the third year the contracts were being used so there is little chance that structural variables concerning the producer organizations and the producers were influenced by participation in contracts. Nevertheless, we collected prior-treatment values for covariates (X_i) as these could be influenced by participation: the ownership of a vehicle, the total value of assets, and access to storage facilities. Contrary to the cropped surface, the irrigated area in 2014 could not have been influenced by participation because of the high land development costs.

Uncertainty on the capacity of producers to fund rice growing and to reach food security during the 10 last years was measured using a Likert scale. The uncertainty indicator ranges from zero to six. Uncertainty perception is not influenced by participation in contract farming because contracts are very recent in the Senegal River valley.

The dependecy ratio is the number of dependents (children below the age of 15 and members unable to work) over the total household size. We use a dummy variable for the ethnic group *Wolof* which is the major one in Senegal. The degree of farm specialization is estimated by the head, and concerns the share of total household income coming from paddy marketing.

Outcome variables (Y_i) are income, production costs, yield and food security. Income indicators are profit per kilogram and price per kilogram. Profit is the difference between the income from the sale and the share of total costs proportionate to the quantities sold. Prices of collective sales were cross-checked with the representatives of the producer organizations and technical advisors. Input costs

includ labor, capital depreciation and interest paid to the bank, in addition to more typical inputs (seed, fertilizers, etc.). The opportunity cost of self-produced or purchased inputs with in-kind payments was worked out based on demand. If there was no demand, the opportunity cost was the production cost. Otherwise, the opportunity cost was equal to its sales price during the period considered (Boussard, 1987). Rice yields are in kilogram per hectare.

Food security is measured using the Household Food Insecurity Access Scale (HFIAS), which focuses on the respondent's perception about the access dimension of food security (Coates et al., 2007; Swindale and Bilinsky, 2006). HFIAS is correlated with other food security indicators such as the coping strategies index, the household hunger scale, the food consumption score, the household dietary diversity scale and the self-assessed measure of food security (Maxwell et al., 2014). The indicator is based on nine questions addressing three facets of food insecurity: anxiety, quantity and quality. Each question is associated with three frequency modalities. It enables calculation of the indicator which ranges between 0 (food security) and 27 (food insecurity). We also broke this indicator down to highlight the aspects of quantity (from 0 to 15) and quality (from 0 to 9) in food insecurity.

3.5. Instruments

The exclusion restriction condition implies that the instrument only influences the outcome through the endogenous variable (Wooldridge, 2010). For this reason, "it is challenging to find a truly exogenous IV that is also strongly correlated with participation in contract farming" (Barrett et al., 2012, p721). In the literature assessing the impacts of contract farming with IV models, the instruments are usually proxies of the transaction costs of contract implementation (Trifković, 2016). The instruments may be related to risk perception, such as respondent trustworthiness (Warning and Key, 2002) or risk aversion to participate in contract farming (Bellemare, 2012). They are also related to the geographical distance of the farm from the contracting company (Rao and Qaim, 2011), the rural bank (Ramaswami et al., 2006), the village leader (Miyata et al., 2009) or the production area and extension offices (Girma and Gardebroek, 2015). The instruments also concern the magnitude of contract farming in the area as providing farmers with easy access to contract: total contracted surface or number of firms (Tilahun et al., 2015), number of integrated farms in a village or number of years since the first contract was set up (Trifković, 2016). Finally, the instruments concern access to information through the social position of the producers (Girma and Gardebroek, 2015), their link with officials (Bolwig et al., 2009) or participation in a producer organization (Rao and Qaim, 2011).

We use two instruments. In the model used to estimate the impacts of the production contract, we use the distance from the producer to the closest rice miller who offer this type of contract. These millers

are located in the north of Dagana Department, and have a collection radius of about 50 kilometers. In the model estimating the impacts of a marketing contract, we use the farmer perception of uncertainty over their capacity to finance a rice crop and to satisfy household food needs.

3.6. Qualitative explanation of impact pathways

The results of the econometric models were discussed with VC stakeholders. Five focus group discussions held in March 2016, each of which brought together between 7 and 25 participants. They were organized at farmer and national development agency levels. They confirmed the results and enabled the identification of certain impact pathways.

4. Results and discussion

We use t tests to compare the characteristics of treated and control groups (table 2). The participation model highlights the drivers of participation in contracts (Table 3). Overlap charts (figures 2, 3 and 4) and tables balancing covariates (tables 7, 8 and 9) are included in appendix 1. Impacts estimated by IV and PSM models are presented in Table 4. Full IV models are presented in tables 10, 11 and 12 in appendix 1. The two types of models yield similar results. The robustness of the PSM models is tested with Rosenbaum bounds tests (table 13 in appendix 1).

4.1. Descriptive statistics of contract and non-contract households

Farms with a contract and those without differ in land, number of active family members, gender of household head, specialization, access to credit, distance from a rice miller offering a production contract and the number of members in the producer organization. In particularly, there are marked differences in the source of seasonal credit. All the farms with a marketing contract have a credit from the national agricultural bank, 53% of farms who sell through spot transactions and 1% of farms with production contracts. The distance from the closest rice miller to offer a production contract also differ significantly: 28.12 km for farms with a production contract, 30.99 km for farms with a marketing contract and 50.90 km for farms who sell their paddy through spot transactions.

Farms in the control group sell 100% of their paddy through spot transactions. Farms with contracts combine two types of sales. The proportion of farms with contracts that also sell through spot transactions is 88.46% for those with marketing contracts and 98.71% for those with production contracts. The proportion of the volume of paddy sold through spot transactions in the total volume of paddy sold is 30% for farms with a marketing contract and 33% for farms with a production contract.

The profit per kilogram made by farms with a marketing contract (FCFA 44.94/kg) is similar to that made by the control group (FCFA 44.30/kg). Farms with production contracts make less profit (FCFA 29.22/kg). The average HFIAS score is 4.95. Farms with a contract have a lower HFIAS score (4.02 in the group with a marketing contract and 4.23 in the group with a production contract) than farms in the control group (5.83).

Table 2 (1/2): Mean comparison of producer characteristics[49]

	Producers who sold through spot transactions. N= 265		Producers with a marketing contract. N = 130			Producers with a production contract. N= 155		
	Mean	S.d	Mean	S.d	t-value	Mean	S.d	t-value
Livelihoods								
Developed area (ha)	1.5	1.58	1.54	0.98	-0.27	2.71	2.58	-5.97***
Number of active members	2.78	1.58	3.15	1.36	-2.28**	4.16	1.93	-7.98***
Experience in rice growing (years)	17.52	10.45	19.08	7.66	-1.51*	18.24	8.79	-0.71
Age of head of household (years)	48.29	11.36	49.76	10.54	-1.23	48.44	10.71	-0.13
Value of non-land assets in 2010 (FCFA)	1795347	4369619	1294650	2577529	1.21	1838887	2428079	-0.11
Dependency ratio (%)	.68	.16	.67	.16	0.65	.57	0.21	6.08***
Female head of household (dummy)	.12	.33	.02	.12	3.72***	.02	.14	3.86***
Ethnic group Wolof (dummy)	.67	.47	.76	.43	-1.83**	.64	.48	0.55
Storage outside in 2010 (dummy)	.22	.42	.18	.39	0.87	.19	.39	0.86
Degree of specialization of farms (%)	.71	.26	.64	.26	2.48***	.71	.25	0.05
Number of members in the producer organization	30.29	43.63	40.37	27.19	-2.41***	20.04	27.56	2.63***
Perception of uncertainty	.77	.59	1.18	.56	-6.56***	1.09	.54	-5.56***
Ownership of vehicle in 2010 (dummy)	.63	.48	.64	.48	-0.38	.67	.47	-0.92
Distance from miller offering a production contract (km)	50.90	27.61	30.89	13.44	7.81***	28.12	12.82	9.67***
Rice growing financed by CNCAS (dummy)	.53	.50	1	0	-10.66***	.01	.11	12.73***

[49] Significant t-test results are indicated as *p<.1; **p<.05; ***p<.01. Source: survey data. Farms that did not grow rice in the 2014 dry season are not included in the control group.

Table 2 (2/2): Mean comparison of producer characteristics[50]

	Producers who sold through spot transactions. N= 265		Producers with a marketing contract. N = 130			Producers with a production contract. N= 155		
	Mean	S.d	Mean	S.d	t-value	Mean	S.d	t-value
Marketing								
Share of producers combining contract and spot	0	0	0.8846	0.3207	-44.95***	0.9871	.1132	-1.0e+02***
Share sold under contract	0	0	.7	.17	-68.11***	.67	.16	-69.27***
Share sold through spot transactions	1	0	.30	.17	68.11***	.33	.16	69.27***
Performance								
Profit per kilogram (contract)	44.30	26.07	44.74	19.6	-0.17	24.26	21.04	8.14***
Profit per kilogram (contract plus spot)	44.30	26.07	44.94	19.97	-0.25	29.22	22.35	6.02***
Price of sales (contract)	124.05	13.9	126.25	7.68	-1.69**	103.88	4.37	17.54***
Price of sales (contract plus spot)	124.05	13.9	126.46	9.16	-1.8**	108.84	6.01	12.92***
Yield (kg/ha)	6,698	1,905	6,487	1,772	1.07	6,822	1,516	-0.68
Production cost (FCFA/kg)	79.74	21.68	81.51	18.94	-0.79	79.61	20.26	0.06
HFIAS total	5.83	4.84	4.02	3.75	3.74***	4.23	4.19	3.44***
HFIAS quantity	0.86	2.63	.18	.62	2.87***	.63	1.49	1.00
HFIAS quality	4.01	2.94	3.14	3.38	2.63***	2.79	2.45	4.34***

[50] Significant t-test results are indicated as *p<.1; **p<.05; ***p<.01. Source: survey data. Farms that did not grow rice in the 2014 dry season are not included in the control group.

4.2. Factors influencing participation

The variable “use of a loan from the national bank” has a strong positive influence on the participation in marketing contracts and a strong negative influence on the participation in production contracts. We do not include this variable in the participation models because it is a prerequisite for participation in marketing contracts and therefore perfectly predicts it. Distance from a rice miller offering production contracts also has a strong negative influence on participation in both types of contracts whereas perception of uncertainty a positive influence. Other drivers are listed in table 3.

Matching performs well in the case of marketing contract (97.69% of treated observations finds a match) and production contract with producers who did not grow rice as control group (86.5% of treated observations finds a match). In the case of production contracts where the producers were funded by the bank in spot transactions as control group, the matching reduces fewer differences in means but 89.03% of treated observations finds a match and the results of the IV models are similar to the results of the PSM.

Table 3: Probit models of participation in marketing and production contracts[51] [52]

	Marketing contract		Production contract			
Control groups	Producers who used a CNCAS loan and sold through spot transactions		Producers who had no CNCAS loan and did not grow rice[53]		Producers who used a CNCAS loan and sold through spot transactions	
Explanatory variables	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Developed area (ha)	-.1277283	.0852572	.1246725**	.0941036	.113973**	.0569132
Number of active members	.5421756***	.1114392	-.1024452	.1152935	.4112823***	.0811513
Experience in rice growing (years)	-.0164054	.0111671	-.0209678	.0171585	-.01982*	.0114519
Age of head of household (years)	-.0058191	.0098015	.0118396	.0174928	-.0058388	.0104103
Value of non-land assets in 2010 (FCFA)	3.15e-08	4.06e-08	-4.70e-08	6.10e-08	3.13e-08	4.65e-08
Dependency ratio (%)	1.434883*	.819641	.5829334	.938945	.1175581	.6299728
Female head of household (dummy)	-2.027782***	.532322	-.4980733	1.302043	-.9163607**	.3967871
Ethnic group Wolof (dummy)	.2586531	.2103199	-.3219547	.3416178	.0803509	.2020467
Storage outside in 2010 (dummy)	.0024852	.2757133			-.0374356	.2407258
Degree of specialization of farms	-.1317255	.3495921	-.0572254	.6167013	.836297**	.3687557
Number of members in the producer organization	.0060427**	.0027263	-.0052203	.0071069	-.0011935	.0033605
Perception of uncertainty	.6236314***	.1631955	-1.24275***	.2043351	.5080035***	.1625587
Ownership of vehicle in 2010 (dummy)	.2146745	.1953337	-.1803656	.3551835	.3597064*	.2006713
Distance from miller offering a production contract (km)	-.0145715***	.0055171	.0070969	.0123152	-.020091***	.0056712
Constant	-2.147944**	.9070439	2.948394***	1.178369	-1.440202**	.7280846
N	271		198		296	
Likelihood Ratio chi2	114.80		110.39		163.12	
Prob > chi2	0.0000		0.0000		0.0000	
Pseudo R^2	0.3059		0.5327		0.3982	
Log likelihood	-130.21892		-48.419611		-123.28277	
Percentage of correct prediction	74.54%		93.43		80.07%	

[51] Significant levels indicated as *p<.1; **p<.05; ***p<.01. Source: survey data.

[52] The variable “use of a loan from the national bank” is excluded from the model because it perfectly predicts participation in marketing contracts.

[53] Storage outside is not included in the production contract model with control group of producers not growing rice because it perfectly predicts success.

4.3. Impact of contracts

4.3.1. Marketing contract

The marketing contract has no impact on income because yields, production costs and sales prices are the same as in spot transactions. Yields and production costs are similar because the technical itinerary is the same in the two groups. Agricultural practices are intensive (Table 5), 98% of producers use certified seed and the average quantity of seed is the same in the two groups (128.3 kg/ha). They also use the same quantity of fertilizer 18-46 (109 kg/ha) and spend the same amount on chemical weeding (FCFA 26.333/ha). Contracted farms use slightly more urea (305 kg/ha) than control farms (276.5 kg/ha) but this does not make any difference in yields (6.487 t/ha).

Second, there is no premium because producers sell paddy of the same quality under a contract and through spot transactions. Indeed, 98% of producers in both groups grow only one variety (Sahel 108). Furthermore, 64.44% of members of producer organizations grow the same variety and 32.22% grow two varieties that are marketed separately. Finally, the storage conditions (which influence the moisture content) are the same whether the paddy is sold under a marketing contract or through spot transactions. This means the price per kilogram is the same under a marketing contract and a spot transaction.

This result differs from the literature on contract farming which reports upgrading of processes and products (Jaffee et al., 2011; Reardon et al., 2009; Eaton and Shepherd, 2001; Gow and Swinnen, 1998). Indeed, we consider a marketing contract whose aim is to influence repayment of the loan and to improve the quality of paddy but not to intensify agricultural practices. Furthermore, intensification of rice growing started in 1973 in the SRV, and there have been no major change in inputs since (Fall, 2006; Bélières and Touré, 1999; Le Gal, 1995). The content of the marketing contract in our study thus differ from the contracts usually addressed by literature on contract farming.

Marketing contracts are shown to slightly reduce producer food insecurity (by 1.33 or 2.67 points depending on the model) through the quantitative dimension (1.47 or 0.68 points). This result is robust, particularly in the case of quantity (gamma=5)[54]. Focus group discussions highlighted that this impact is due to the mitigation of price seasonality. Indeed, the price of a marketing contract ranged from 112.5 FCFA/kg in July to 137.5 FCFA/kg in December, whereas the price of spot transactions ranged from 83.35 FCFA/kg to 150 FCFA/kg over the same period. The loan was repaid by 73.58% of producers in July or

[54] A high value of gamma indicating insensitive results (Rosenbaum, 2005).

August, when the price obtained through spot transactions was lower than that obtained with a marketing contract. This means that with a marketing contract, producers supplied less paddy to repay the same amount of loan as when they sold the rice through a spot transaction. This enabled them to put aside more paddy for home consumption and other uses. The positive impact of contract farming on farmer food security is also reported in the literature (Bellemare and Novak, 2017).

4.3.2. Production contract

First, we compare the performance of producers with a production contract with the performance of producers who did not grow rice because they could not afford to. Making this comparison implies that we consider that a production contract is the only way to fund rice growing for these producers. The control group comprises producers who owed money to CNCAS during the 2014 dry season and who thus could not afford to grow rice. Models yield results that are intuitive because the performance of the control group in terms of yield, costs, price and profit is zero.

Production contracts have a positive impact on producer incomes and food security. Yields reach 7.4 tons per hectare and the cost per kilogram of paddy produced is FCFA 75.54. The profit per kilogram is FCFA 28.54 for sales under a contract and increases to FCFA 33.46 when we include spot transactions. Food security is also improved. These results are robust to omitted variable (gamma=6.1 for profit and 22.6 for selling price). They are in line with the literature on contract farming which reports upgrading through access to inputs on credit (Jaffee et al., 2011; Reardon et al., 2009; Eaton and Shepherd, 2001).

Second, we compare the performance of producers with a production contract with the performance of producers with a CNCAS loan who sell their rice through spot transactions. We find a negative impact on income and no impact on food security.

The negative impact of production contracts on the profit per kilogram varies depending on the model, either FCFA 15.63 (38.81%) or FCFA 23.10. The result is robust (z-value=-5.92 and gamma=4.8) and was confirmed during focus group discussions. This impact is not explained by differences in yields and production costs because there is no difference in agricultural practices (Table 5). Rice millers who offer production contracts provide inputs and technical support that are similar to those provided by SAED. Producers in both groups use the same quantities of certified seed (126kg/ha), of fertilizers (102 kg/ha for 18/46 and 263.5 kg/ha for urea) and spend the same amount in chemical weeding (23,553/ha).

The difference in benefit is explained by a lower selling price (FCFA 17.26/kg or FCFA 25.03/kg depending on the model). The result is robust (z-value=-21.24 and gamma=27). That lower selling price is not due to lower quality because farmers with a production contract sell the same paddy through spot

transactions (Sahel 108 for 91.61% of them) and the price is FCFA 103.88/kg with a production contract and FCFA 119.09/kg through spot transactions.

The lower sales price under a production contract is due to the inclusion of implicit costs of interest and insurance. First, the oligopsonistic structure of the credit market in which producer organizations excluded from the national bank are obliged to participate favors higher interest rates. Farms in the SRV are specialized (an average of 69.08% of their income comes from paddy) and the high cost of growing rice (FCFA 509,157 per hectare) requires the use of external funding. A production contract is often the only remaining option for producers who are excluded from the national bank. Indeed, tied input-output relationships are limited in the area (they concerned only 0.91% of producers in 2014). Only three millers offered a production contract in 2014, and this segment of the market is not regulated either by the state or by the interprofessionnal organization. This last chance to obtain a credit favors high rates of interest set by millers operating on an oligopolistic market.

Second, producers excluded from CNCAS credit represent a high risk of non-reimbursement for millers who offer production contracts. In the 2014 dry season, the three millers reported rates of reimbursement ranging from 70% to 90% of the total amount lent. To make up for their losses, millers include an implicit insurance cost. If a producer does not reimburse the rice miller, a new contract may be set up the following season with stricter surveillance to be sure the producer reimburses the previous credit and the new one. Technicians visit the plot more often and obtain power of decision over the main technical steps (sowing, use of chemical inputs, irrigation and harvest). The insurance cost is used to fund this closer surveillance. It may also cover part of the losses when there is no possibility of taking out a new contract.

We conclude that production contract is used as a funding mechanism by producers excluded from the national bank. It includes interest and insurance costs linked to the credit. We cannot disentangle the respective share of the interest and implicit insurance costs. It does not increase yields or the quality of the product, and therefore does not increase the sales price. That is why none of the producers sold more paddy through production contract than the volumes corresponding to the value of the credit.

Finally, the difference in profit per kilogram is reduced by 24.67% when we include spot transactions by producers with a production contract (gamma=13.4 and z-value=-4.35). This is due to the reduction in the difference in the sales price. Undertaking spot transactions combined with a production contract thus increases the producer's average profit.

Table 4: Impacts of marketing and production contracts on the income and food security of small-scale producers[55]

	Control group		Indicators	Instrumental variable models		Nearest Neighbor Matching		
				Coef.	z-value[56]	ATT	ATT %[57]	T-stat
Marketing contract	Producers who used a CNCAS loan and sold through spot transactions	Contract only	Profit per kilogram	-13.761	-1.04	1.74		0.43
			Price of selling per kilogram	3.354535	0.76	2.74		1.61
		Contract plus spot	Profit per kilogram	-12.58946	-0.96	1.97		0.49
			Price of selling per kilogram	4.526075	0.87	2.97	2,41%	1.70*
		Production	Yield (kg/ha)	-141.7626	0.15	-112		-0.41
			Production cost per kilogram	-11.2824	-1.07	1		0.27
		Food security	HFIAS total	-2.677529	-1.76*	-1.33	-24,81%	-1.65*
			HFIAS quantity	-1.474431	-1.95**	-.68	-78,16%	-1.83*
			HFIAS quality	-1.235247	-1.34	-.37		-0.66
Production contract	Producers who had no CNCAS loan and did not grow rice	Contract only	Profit per kilogram	28.54	8.27***	24.26		14.36***
			Price of selling per kilogram	104.09	152.97***	103.87		296.09***
		Contract plus spot	Profit per kilogram	33.46	9.05***	29.22		16.28***
			Price of selling per kilogram	109	113.96***	108.83		225.45***
		Production	Yield (kg/ha)	7054.72	28.53***	6821		56.03***
			Production cost per kilogram	75.54	22.48***	79.61		48.92***
		Food security	HFIAS total	-2.43	-2.97***	- 3.36		-4.09***
			HFIAS quantity	-1.44	-3.54***	-.62		-3.02***
			HFIAS quality	-.71	-1.71*	-1.94		-3.15**
	Producers who used a CNCAS loan and sold through spot transactions	Contract only	Profit per kilogram	-23.10037	-5.92***	-15.63	-38,81%	-3.13***
			Price of selling per kilogram	-25.03085	-21.24***	-17.26	-14,25%	-8.53***
		Contract plus spot	Profit per kilogram	-17.441	-4.35***	-10.63	-26,39%	-2.11**
			Price of selling per kilogram	-19.37148	-14.40***	-12.27	-10,13%	-5.97***
		Production	Yield (kg/ha)	-112.8788	-0.48	311.2		1.04
			Production cost per kilogram	-1.930484	-0.53	-1.63		-0.37
		Food security	HFIAS total	1.909277	0.66	-.30		-0.31
			HFIAS quantity	1.953949	1.35	-.13		-0.32
			HFIAS quality	-2.066642	-1.44	-.19		-0.29

[55] Significant levels indicated as *p<.1; **p<.05; ***p<.01. Source: survey data.

[56] Values are the results of a t-test for the control group "Producers who did not use a CNCAS credit and did not grow rice."

[57] We do not provide ATT % in the case of the control group « Producers who had no CNCAS loan and did not grow rice » because their performance is zero

Table 5: Impact of contracts on agricultural practices (Nearest Neighbor Matching algorithm)[58]

	Indicators of agricultural practices	Control	Treated	T-stat
Marketing contract	Certified seeds (%)	.98	.96	-0.58
	Quantity of seeds (kg/ha)	128.3	129.9	0.30
	Cost of weeding (FCFA/ha)	26333	23942	-1.16
	Quantity of organic fertilizer manure (kg/ha)	0,00	0,00	.
	Quantity of chemical fertilizer 18/46 (kg/ha)	109	105.5	-0.66
	Quantity of chemical fertilizer urea (kg/ha)	276.5	305	1.87*
	Mechanized harvest (%)	0.01	0,00	-0.50
Production contract (Control group comprises producers who have no CNCAS loan and do not grow rice)	Certified seeds (%)	0	.95	57.06***
	Quantity of seeds (kg/ha)	0	131.81	56.67***
	Cost of weeding (FCFA/ha)	0	25727	34.11***
	Quantity of organic fertilizer (manure) (kg/ha)	0	0	.
	Quantity of chemical fertilizer 1 (18/46) (kg/ha)	0	101	39.89***
	Quantity of chemical fertilizer 2 (urea) (kg/ha)	0	294.5	72.94***
	Mechanized harvest (%)	0	.045	2.7**
Production contract (Control group comprises producers who use a CNCAS loan and sell through spot transactions)	Certified seeds (%)	.99	.95	-1.29
	Quantity of seeds (kg/ha)	126	132	1.03
	Cost of weeding (FCFA/ha)	23553	25518	0.84
	Quantity of organic fertilizer (manure) (kg/ha)	0,00	0,00	.
	Quantity of chemical fertilizer 1 (18/46) (kg/ha)	102	99.5	-0.32
	Quantity of chemical fertilizer 2 (urea) (kg/ha)	263.5	294.5	1.59
	Mechanized harvest (%)	.02	.03	0.5

[58] Significant t-test results are indicated as *p<.1; **p<.05; ***p<.01.

5. Conclusion

Most of the literature reports that contract farming in export VCs of high-value products favors access by small-scale producers to improved inputs, technical advisory services and remunerative markets (Jaffee et al., 2011; Reardon et al., 2009; Eaton and Shepherd, 2001). But much less information is available about the impacts of the contracts emerging in domestic grain chains in Africa. In this paper, we test the hypotheses that in domestic grain chains contracts improve farmer incomes and food security. The case studied is the rice VC in the SRV, where credit policies support the implementation of marketing contracts and millers offer production contracts. We use instrumental variables and propensity score matching models to correct selection bias on a dataset of 594 observations.

We find that marketing contracts have no impact on producer incomes. The technical itinerary used by producers with a marketing contract is the same as that used by producers with a loan from the national bank who sell their paddy through spot transactions. Indeed, they are both promoted by the national agricultural agency. Furthermore, there is no premium because the quality of paddy sold by producers with a marketing contract and through spot transactions is the same. As a result, a marketing contract does not lead to upgrading of producers. It is an organizational device that ensures that the producers repay their loans and that millers receive the supplies they need. It nevertheless slightly decreases producer food insecurity because it mitigates price seasonality. Indeed, producers sell their paddy to reimburse their loan during the two months following the harvest, when the price under marketing contracts is higher than the spot market price.

Production contracts have a positive impact on the income of producers who have no access to credit from the national bank because they represent the only recourse these producers have to fund rice growing. Nevertheless, the income of producers with a production contract is lower than the income of producers with a loan from the national bank who sell their paddy through spot transactions. Indeed, a production contract includes implicit interest and insurance costs that represent the costs of the loss of access to credit at the national bank. Finally, the combination of production contract and spot transactions by producers increases their profit.

In the Senegal River valley, policies need to tackle the negative impact of the exclusion from the credit at the national bank on farmer income. They have two non-exclusive options. First, an insurance system that was introduced a few years ago in Senegal could prevent producer organizations that are unable to repay loans from being excluded by the national bank and from turning to less profitable marketing options. However, the development of insurance systems for agricultural credit in Africa faces the challenges of adverse selection and moral hazards. Research is needed to understand the drivers of loan

default by producers in order to design an appropriate insurance system for agricultural credit. Second, the production contract could be considered as providing the best insurance system for producers who present a higher risk of loan default. But it is not clear how the implicit interest and insurance costs are determined, or how the imbalance of power, due to the oligopsonistic market structure and lack of funding opportunities for producers, influence the selling price. The negotiation of the production contract price, with a specific breakdown of its components, should be an inherent focus of the interprofessional organization.

CHAPTER 5: CONCLUSION

1. Aims of the study

The debate over the contribution of domestic food chains to food security and income generation was revived by the recent food price crisis. In Asia, some research documents the modernization of domestic food chains, enhanced by the demand for higher-quality products, public investment in infrastructures, the green revolution and opening up to foreign investments. The midstream segment of some food chains underwent a technical change and integrated the function of collection (Reardon et al., 2012). It led to an increase in the total added value due to improved product quality. This increase is favorable to the midstream segment, which adds new quality attributes. Producers do not benefit directly from higher retail prices although they may get a slightly higher income in absolute terms (Minten, Murshid, et al., 2013; Reardon et al., 2012).

The African context of domestic food chains presents some similarities with the Asian case. In particular, policies aim at supporting the modernization of domestic food chains by increasing agricultural yields and developing new ways of linking farmers to markets. The general objective of this thesis is to contribute to the knowledge about the organization of domestic food value chains (VC) in Africa and their economic and social implications for small-scale farmers. I first question the existence of a quiet revolution in Africa. I then address the inclusion of producers in the modernization with a specific interest in their combination of marketing modes. Third, I assess the impacts of contract farming on farmer incomes and food security. I also expand the analysis of the effects of investments from agribusinesses on the participation of small-scale producers in the management of agricultural resources, on the sustainability of agricultural practices and on land access.

I use the Global Value Chain (GVC) theoretical framework to address the effects of technical change and of the tendency of governance towards vertical integration on farmers in Africa. This framework analyzes the links between the technology, the driving of the quality, the skills and the distribution of value added among the stakeholders. In particular, it analyzes how the driving of the quality may generate barriers that exclude certain suppliers, while including and upgrading others. I also use in chapter three the frameworks of livelihoods and plural forms, which explain the marketing strategies of producer in relation to their capital and perception of uncertainty.

Empirical work was done about the rice VC from the Senegal River Valley (SRV). I use different methods. I conducted 154 interviews with VCs stakeholders and use quantitative data from 90 producer organizations, 607 small-scale producers, 49 processing units and 304 traders. Quantitative data were analyzed with multinomial logit model and quasi-experimental methods for impact evaluation.

2. Main findings

The first hypothesis is that in Africa the governance of domestic food chains is driven by the midstream segment and tends towards vertical integration, which is similar to the Asian revolution. This is validated, although the magnitude and drivers of the modernization differ.

The rice VC is undergoing modernization in ways similar to those described by Reardon et al. (2012). Favorable contextual factors are the increase in prices on the global market in 2007/2008, public policies set up in response and the increasing demand for quality products. Processors invested in technologies that improve yields and quality, and set up contracts and hierarchical control of production. Millers define the quality criteria of paddy and rice. Marketing contracts are written agreements about the marketing price, the quality of paddy and bank credit. Production contracts are written out with an explicit accounting of the inputs or cash provided at credit. Producers sell to the miller the quantity of paddy equivalent to the amount of the credit. There are millers that also directly grow rice. Industrially milled paddy increased to 45,000 tons in 2014, and the increase in the total net margin along the chains benefits the midstream segment. Nevertheless, there are three differences between the modernization that took place in Senegal and that in Asia. The first difference is that in Senegal the benchmark situation is a spot transaction with a relational tendency between producers and village traders, and not a tied credit-output transactions as in Asia. Indeed, in Senegal, the state since 1964 has used credit to support production, first through distribution of inputs on credit and then through the setting up of a national bank. As a result, tied credit-output transactions between producers and village traders were not developed. Furthermore, in Asia, the function of collection which was carried out by small-scale traders was integrated by large processors. In Senegal, this function was already being performed by processors. The second difference is that in Senegal policies directly contribute to the tendency of governance towards integration. Credit policies are used to support the modernization through implementation of marketing contracts to secure the qualitative and quantitative aspects of miller supplies and to avoid loan default with the national bank. Furthermore, because of non-repayment of previous credit, certain producer organizations were excluded from credit by the national bank. Some rice millers offer them production contracts, which is another type of vertical coordination. The third difference is that the modernization of the rice VC in Senegal does not make the domestic sector competitive relative to imports. The volumes processed by modern millers in Senegal are limited because they face shortages of paddy. It generates high capital depreciation costs per kilogram and impedes the competitiveness of the modern rice VC relative to imports of broken rice. Large-scale processors stay in business thanks to state intervention. As a result, Senegal produced around 20% of

national consumption in 2014, and the modern domestic VC supplies 2.6% of it. This is a major difference with the People's Republic of China, India and Bangladesh, which are close to self-sufficiency.

The second hypothesis is that plural forms of coordination can be explained by the financing dimension of producers' livelihood and their strategies to reduce uncertainty. This has been validated.

Rice producers in the SRV have several marketing options that they use and combine according to their livelihoods and perception of uncertainty. The main driver to participation in marketing and production contracts is the financial requirement of farms, mainly represented by the access of producer organizations to credit with the national bank. In Dagana Department, farmers growing rice are specialized and commercial banks are limited. The national bank is the main source of credit. Until 2010, when funded by this bank, farmers combined two types of spot transactions (including relational components): collective sales to repay the loan and individual sales to meet household's needs. However, information imperfection and enforcement failure have led to low reimbursement levels and the bank has followed several recovery plans. Policies recently set up marketing contracts to secure the reimbursement of credit in addition to improving miller supplies. The bank promotes the use of marketing contracts. Producers allowed to use a credit at the bank are therefore more likely to participate in marketing contracts, especially when they perceive high uncertainty over access of credit, outlets and price fluctuations. On the contrary, producer organizations excluded from credit by the national bank have few financing options. Exclusion from credit at the national bank has therefore a positive influence on participation in production contracts when farms are within the activity radius of rice millers that make such agreements available. Therefore, the segmentation of the credit market is linked to the indebtedness of producers to the bank. The second driver that encourages producer organizations to participate in production contracts is the perception of uncertainty over delays in access to inputs and price fluctuations. There is also a category of producers which is specialized in rice growing, excluded from the national bank credit and located beyond the reach of rice millers offering production contracts. This category has no other source of credit and was thus unable to grow rice in the dry season of 2014.

The third hypothesis is that (1) contracts in domestic grain chains improve farmer incomes through access to credit, improved inputs and technical advice, thereby increasing yields and improving quality, and (2) contracts improve farmer food security by increasing their incomes. This has been partially validated.

Most of the literature reports that contract farming in export VCs of high-value products has a positive impact on farmer incomes. It considers a context where non-contracted farmers have little access to credit, inputs and knowledge. Contracts upgrade producers by providing them with improved inputs and technical advisory services, resulting in higher yields and selling prices (Prowse, 2013; Jaffee et al., 2011; Reardon et al., 2009; Eaton and Shepherd, 2001; Gow and Swinnen, 1998).

The case of the SRV documents different impact pathways. Indeed, the state extension services started in 1973 (Le Gal, 1995) and now reach a majority of rice producers. The technical itinerary used by producers with marketing contracts is the same as that used by producers with a loan from the national bank who sell their paddy through spot transactions. Indeed, they are both promoted by the national agricultural agency. Furthermore, there is no premium because the quality of paddy sold by producers with marketing contracts and through spot transactions is the same. Marketing contracts are organizational devices that ensure producers repay their loans and that millers receive the supplies they need. Nevertheless, marketing contracts have a small but significantly positive impact on farmer food security, mainly in its quantity dimension, because they mitigate price fluctuations compared to spot transactions. After harvest, the marketing contract selling price is higher than for spot transactions. Producers therefore do not need to supply as much paddy to repay their loans and retain more for personal consumption.

Production contracts have a positive impact on the income of producers who have no access to credit at the national bank because they represent their only option to fund rice growing. It is therefore the credit dimension of this type of contract which has a positive impact on farmer incomes. Nevertheless, the income of producers with production contracts is lower than the income of producers with a credit from the national bank who sell their paddy through spot transactions. The lower income per kilogram is explained by the lower selling price. This price is lower because it includes implicit interest and insurance costs. The oligopsonistic structure of the credit market in which producer organizations excluded from the national bank are obliged to participate favors higher interest rates. Furthermore, producers who have been excluded from CNCAS credit represent a high risk of non-reimbursement for millers who offer production contracts. The selling price includes an implicit insurance cost which is used to fund closer surveillance by the buyer. Nevertheless, it is not possible to disentangle the respective share of the implicit interest and insurance costs. Because of this lower price, 100% of producers participating in production contracts supply no more than the quantity of paddy equal to the value of the credit. As a result, production contracts resemble informal credit arrangements because screening, monitoring and enforcement are rooted in geographical and relational proximity. They nevertheless

differ because they are written, with explicit accountability, and include complex indicators of quality. Production contracts do not make a difference in terms of agricultural practices and yields because millers supplying inputs within production contracts are only an additional intermediary between input providers and producers, and their advisors recommend the same technical operations as public advisors.

The research presented in Appendix 3 (chapter 6) tests two hypotheses. The first one is that the combination of vertical coordination and large-scale investments reduces the participation of small-scale farmers in the management of agricultural resources of the territory. The second hypothesis is that these investments have varying effects, according to the types of producers, on land access, agricultural practices, food security and income. These hypotheses are partially validated.

Policies encourage agribusiness to invest in production and transformation. They also support contractual and wage relationships with small-scale producers. First, the case studies show that the effects of large-scale investments on the participation of small-scale producers in the management of agricultural resources depend on the consideration of customary and legal institutions. Indeed, the negotiation between agribusinesses and small-scale producers should consider informal institutions, in addition to identifying effective legal enforcement mechanisms. Second, the study shows that investments have different effects according to the types of producers. Growers benefit from the extension of irrigated land and from technical advisory and credit services. On the contrary, agropastoralists see the reduction of their access to water, pastureland and rainfed land informally owned because of land grabbing. Nevertheless, a part of them accept it because agribusinesses provide goods and services that should be supplied by public policies but are not. Furthermore, the hierarchical control of rice production brings about an increase in the cultural intensity which may decrease the renewal of soil fertility despite the use of lower amounts of inputs per hectare per season.

3. Policy recommendations

Policies implemented after the world price crisis in sub-Saharan Africa aim at increasing agricultural production and modernizing some domestic food chains in order to contribute to national and regional food security. Demont and Rizzotto (2012) proposed a sequential action to modernize the rice VC in Senegal. The first step is to enhance rice quality, through contracts, improved post-harvest practices and investment in processing techniques. The second step aims at increasing scales, through investment in storage infrastructure and increasing the working capital of millers. The third stage is promotion of domestic rice in order to accelerate the transformation of consumer preference. Most of these

recommendations were implemented. Nevertheless, the modernization of the rice VC is facing a number of challenges that are highlighted by this thesis.

First, a segment of the credit market makes small-scale farmers generate less income than if they were funded by the national bank. Indeed, some farms which are members of producer organizations excluded from credit with the national bank enter production contracts which are less profitable per kilogram than the spot transactions when producers are funded by the national bank. This lower benefit does not support the modernization.

Second, the modernization process faces difficulties in moving from the stage of quality improvement to an increase in quantity. Producers market through contracts the volume of paddy needed to repay their loans. Sales beyond that are made to *banabanas,* with whom they share proximity. *Banabanas* pay quickly in cash and use simple techniques only performing the function of husking. It results that the traditional VC supplies rice containing impurities and with moisture rates that make cooking difficult. Nevertheless, this VC is price-competitive with imports thanks to low processing costs. On the contrary, the modern VC, which provides rice of a quality quite similar to imported rice, is not able to compete in terms of price. The quantity of paddy collected by industrial rice millers is limited because it is closely linked to the loans available to producers. It generates high capital depreciation costs per kilogram. The government intervened to get importers to purchase domestic rice in proportion to their share in total volumes imported. But the agreement with importers is not sustainable because with the increasing volume of domestic rice, imports will decrease and importers will lose interest in that agreement.

Third, the modernization process gives little heed to the traditional processing sector (Cadilhon et al., 2007). Few of them benefited from support from development agencies but policies increasingly promote large investments from foreign companies through the national agency called APIX (Investment Promotion and Major Projects). These investments notably concern large husking mills. This could have severe implications for the 450 traditional processing units, their employees and the thousands of small-scale traders living from rice marketing.

Fourth, rice millers, who are supported by the national self-sufficiency policy, aim at exporting their production. Indeed, whole-grain rice in Senegal is a niche segment which will be rapidly filled by domestic production. Since margins are higher on this type of rice, which represents around two-thirds of the production of industrial rice millers, they will try to identify other markets, probably in the region. This rationale goes against the national policy aiming at self-sufficiency. Nevertheless, it is not out of line with the regional agricultural policy, which is looking to a better integrated regional market to ensure

food security in West Africa. But transportation infrastructures in West Africa are of moderate quality, which increases marketing costs. This could play against the competitiveness of Senegalese rice.

I propose three recommendations to support the modernization of the domestic rice VC. The first recommendation is to carry out research to understand the drivers of loan default by producers in order to design an appropriate insurance system for agricultural credit. The implementation of an insurance system (started few years ago in Senegal) could prevent producer organizations unable to repay loans from being excluded by the national bank and from turning to less profitable marketing options. Nevertheless, the development of insurance systems for agricultural credit in Africa faces several challenges. There are issues involving adverse selection and moral hazards that require costly information systems to be overcome. Furthermore, there are many risks that require insurance coverage, and some of them such as civil security, are not usually covered. Finally, certain risks such as climatic shocks may affect large areas, which may compromise the principle of solidarity among producers in the same region. Research projects are needed to understand the drivers of loan default by producers in the Senegal River valley, and to develop an appropriate insurance system for agricultural credit. There is a particular need to develop an information system on the risks, their magnitude and their effects on farmers. Similarly, production contracts could be considered as providing the best insurance system for producers who represent the highest risk of loan default. Nevertheless, it is not clear how the implicit insurance cost is determined, and how the imbalance of power, due to the oligopsonistic structure of the credit market and the lack of funding opportunities for producers, influence the implicit rate of interest. The negotiation of the production contract price, with a specific breakdown of its components, should be an inherent focus of the inter-professional organization.

The second recommendation is to include small-scale processors in the modernization process through the promotion of semi-industrial techniques and the opening up of operating and equipment loans. The policy sequencing proposed by Demont and Rizzotto (2012) faces difficulties in moving from the stage of quality improvement to increase in quantity. The policies implemented aim at replacing the traditional processing sector by the modern one, instead of modernizing the traditional sector. A way to avoid the shortfalls experienced by industrial rice millers is to include the *banabanas* in the modernization of the VC. The traditional VC has existed since the early phase of rice marketing in Senegal and still prevails despite several attempts at replacement. It should be considered as an opportunity for modernization since it has strengths that industrial units do not have. Small-scale units are able to get their supplies thanks to proximity with farmers, and they operate at low cost. Nevertheless, they face two constraints. The first one is technical, since their processing units only perform the husking function and output low

quality rice. The quality of their production may be improved by helping them get access to compact unit rice millers (Cruz, 1999), which separate the hulling and blanching operations and may be coupled with a grader. Such semi-industrial techniques would increase processing yields, and bring the rice quality up to the level of industrial millers (Cruz, 1999). It would also enable small units to keep their flexibility and lower operating costs. Nevertheless, the compact unit requires importing rubber rolls, so national stocks need to be established. The second constraint faced by banabanas is financial. The cost of compact units is more than FCFA 2 million, which is twice the price of the units they currently use. Investment loans could be offered by CNCAS, with guarantees and insurance. Furthermore, banabanas have a limited cash flow. I therefore recommend the opening up of investment and operating credit to small-scale processors. The inclusion of these traditional processors in the modernization process would have pro-poor effects, particularly targeting youth and women (Clayton et al., 2013).

The third recommendation is to support the use of technology to reduce costs at the production level in order to improve the competitiveness of the modern VC. Policies could support the use of mini-harvesters, thus reducing one of the main costs (Paman et al., 2014). The use of such harvesters would decrease the quantity of labor for harvesting and in-kind payment for threshing. Nevertheless, collective action issues could hinder the efficiency of using combine harvesters, whether they are handled by farmer organizations or provided by private companies. Specific feasibility studies should consider the development of small-scale farmer mechanization in the SRV.

4. Limitations

This thesis has limitations regarding the issues addressed, the theoretical framework, the case selected and the method. They could influence the validity of the results.

The main limitation is linked to the comparative approach between the Asian and African continents. The analysis of domestic VCs in Africa is justified by a similar context with regard to the Asian modernization process, mainly in terms of demand, world food prices and policies. Nevertheless, differences might appear, such as in terms of rice self-sufficiency between the two continents prior the world food price crisis, making such a comparison difficult. Furthermore, I consider both continents as being composed of homogenous countries, whereas countries differ greatly although in the same part of the world. In particular, policies are heterogeneous between the different regions of sub-Saharan Africa, and the exposure to imports is different between coastal and landlocked countries. I will further develop the limitation as to the representativeness of the Senegalese case.

Second, the use of the governance theoretical framework is not without limitations. The first is linked to the choice of this framework itself to make a comparison with a case using a different framework. Indeed, the Asian modernization was highlighted by using the Structure-Conduct-Performance framework, and I compare it with the Senegalese modernization that I analyze with the governance framework. It may be argued that the differences highlighted are due to differences in the theoretical frameworks and not in the case studied. The main difference could arise from the analysis of the institutional environment, for instance the focus on various uncertainties or policies. Nevertheless, documents covering the Asian quiet revolution provide enough details to understand it in terms of governance. The second limitation in my use of the governance framework is that it does not focus on the relationships among all the stakeholders in the VC but on bilateral relationships. As a result, I did not analyze in depth the relationships among all the VC stakeholders since I do not present a typology of governance modes from rice millers to retailers. There could be some features of downstream governance that would take part in the driving of the VC, particularly in link with the credit arrangements provided by importers to retailers. The third limitation is that the governance framework does not analyze horizontal coordination. Indeed, in Senegal, most small-scale producers are members of producer organizations which may differ in size, area, leadership, and experience. Rationales regarding collective action such as rice marketing may vary. Variables of producer organizations are introduced in the models, but others may have been overlooked since producer collective action was not a particular focus of the thesis.

Third, there are limitations due to the selection of the rice VC from the SRV to represent the dynamic in sub-Saharan and West Africa. Indeed, the Senegalese case may have limited external validity since most of the national demand is for broken rice, a unique feature of Senegal. Furthermore, the exposure of the country to imports is also due to its coastal location, and for this reason it does not represent landlocked countries. Finally, the selection of the SRV has limited representativeness since it is a territory where rice-growing practices are intensive, whereas most small-scale rice growers in sub-Saharan Africa rely on rain-fed and extensive agricultural practices.

Fourth, the methodological setup of this thesis has limitations. To start with, the thesis is based on a cross-sectional survey which could yield results biased by specific events which happened during the reference year. The 2014 agricultural seasons may be considered as “normal” in terms of yields. But the context of the VC during that year could be considered as specific, with the low rice price on the global market and the policy ensuring rice marketing through an agreement involving importers in the domestic VC. Such specific factors could limit the external validity of results. Furthermore, the decision

to become involved in contracts is based on a producer's characteristics such as experience or indebtedness, which evolve over time. As a result, participation in contracts should be analyzed with a dynamic approach and longitudinal surveys. Due to time constraints, the thesis did not allow such an approach. The second methodological limitation is linked to the impact evaluation models used to correct selection bias. Such methods were developed by sciences in which the researcher has total control over the experiment. They rely on the hypothesis that control and treated groups have similar features, and that their difference in participation is due to external random factors. Nevertheless, using them in development economics raises the risk that the researcher overlook fundamental differences in the two groups in order to comply with this methodological hypothesis. The third methodological limitation is due to the way the impact estimation methods were used. Characteristics of producers may have been overlooked, which can be a source of endogeneity. As explained earlier, I did not use longitudinal surveys and therefore could not use the "difference-in-difference" method which enables correction for time-constant omitted variables. There could also be contagion effects, such as how the price negotiated in spot transactions could affect, or be affected by, prices implemented within contracts.

5. Research agenda

The first dimension of the proposed research agenda concerns the transformation of domestic food chains in sub-Saharan Africa. First, there is a need to extend research to other West African countries, such as Burkina Faso, Côte d'Ivoire and Mali, where integrated forms of coordination seem to be developing in the rice VCs. Such research could use this thesis as a comparative point to identify the influence of a particular institutional environment on food chain transformations, with a particular focus on the effects of credit policies. Second, there is a need to keep focusing research on the midstream segment. Indeed, current policies and research work mainly target the production and consumption levels, whereas transformation of the midstream segment is required to connect both. Analysis of the transformation of processing and trading in terms of institutional organization, technology and scale of activity is necessary. Third, there is still a debate about the economic performance of the vertical and horizontal coordination processes. There is a need for more research comparing vertically integrated large-scale private investment with cases of horizontal coordination. New forms of organization combining both are emerging in West Africa (Donovan et al., 2007), such as the social business model "Entreprises de Services et Organisations de Producteurs" in Benin (Maertens and Vande Velde, 2017). All such forms of coordination must be linked with changes in the performance of domestic food chains and be assessed in terms of distribution of income, competitiveness in terms of quality and price, in addition to their contribution to food security. Fourth, the implementation of such research requires the

use of approaches and theoretical frameworks taking into consideration the institutional environments and precisely addressing the various forms of governance. It is necessary to keep testing the relevance of the GVC theoretical framework to study domestic food chains. On the other hand, it may be rounded out by frameworks addressing other dimensions.

The second dimension of the proposed research agenda concerns the effects that modernizing VCs have on stakeholders and territories. First, research should focus on the drivers of participation of small-scale farmers in transforming VCs, and particularly the influence of the time factor. Indeed, the processes of participation should be studied, taking into consideration the changes in producer characteristics over time, notably experience. Farms must be monitored over several seasons and data analyzed through typologies and longitudinal econometric models. Second, there is the need to document the contribution of VCs to rural transformation. VCs may contribute to territorial development thanks to the geographical reorganization around the generation and control of resources. Comparative and historical approaches may be useful in coming to an understanding of such dynamics. They may highlight the superposition of VCs and territorial governance in relation to changes in the institutional environment over time. Third, a particular focus on the structural transformation of farms may contribute to the understanding of rural transformation. It would be interesting to track the paths taken by farms included and excluded in integrating VCs, or linked to large-scale investments, in order to understand the differences in patterns of specialization and diversification, and their ability to generate employment (Maertens, 2009). Fourth, research must keep documenting the effects that VCs undergoing transformation have on smallholders. Indeed, there is no agreement on the effect of the tendency of governance towards vertical integration on the economic performance of small-scale producers. Income indicators can also be extended to other stakeholders less often studied by researchers, such as small-scale processors or traders. Fifth, more indicators must be used to assess the effects of access to new chains on the sustainability of farms (Requier-Desjardins and Carimentrand, 2009). These new indicators include food security and nutrition (Maestre et al., 2017), empowerment of women (Van den Broeck and Maertens, 2015, 2017) and agricultural practices (Lambrecht et al., 2016; Van den Broeck and Maertens, 2016). Sixth, the development of analysis frameworks, methods and indicators of sustainability must also be extended to VCs and territories, and be able to highlight the tensions generated between different groups of stakeholders around the control of territorial resources.

The third dimension of this agenda is the dissemination of the research results and recommendations to policymakers. Indeed, policymakers in West Africa focus on the capacity of domestic food chains to contribute to national food security through price and quality competitiveness. Nevertheless, they have

less information about the contribution of these chains to job creation, territorial development and other indicators cited above. Public decision could be supported by providing information to policymakers. As developed by the policy recommendations, an interesting issue raised by this thesis which could be discussed with policymakers is whether to have traditional VCs replaced by modern VCs, or to modernize traditional VCs.

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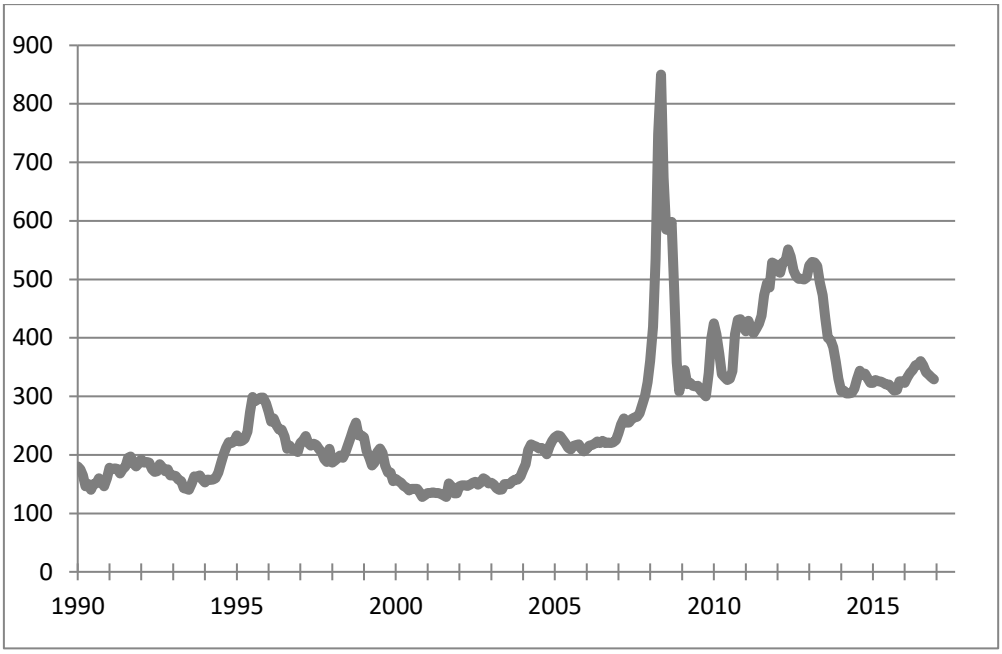
APPENDICES

1. Chapters' appendices

1.1. Appendices - Chapter 2

Figure 1: Price of Thai A1 Super 100% Broken rice 1990–2016



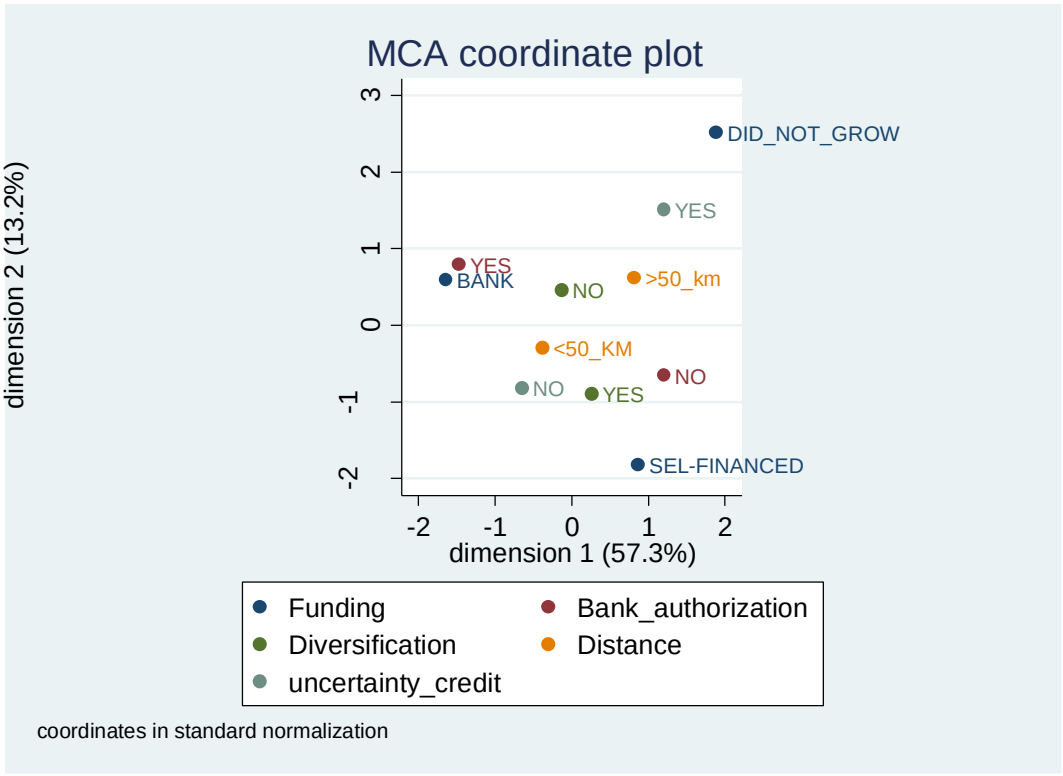
Source: Data from OSIRIZ/InfoArroz

1.2. Appendices - Chapter 3

Table 6: Measurement of forms of uncertainty using a four point Likert scale

Name of variable	Respondent	Sentence[59]
Obtaining a credit from CNCAS	Producer	I may not obtain a credit to grow rice
Delay in credit and inputs	President	Credit and inputs take time to be attributed, so rice sowing may be delayed
Quality of inputs	President	It's difficult to assess the quality of the seed
Degradation of paddy	President	The quality of the paddy may decline between harvest and collection by the purchaser
Variety consistency	President	The purchaser will not take the whole stock of paddy if different varieties are mixed
Identification of a purchaser	President	It is difficult to identify a purchaser of paddy
Risk the purchaser may not pay	President	The purchaser of paddy may not pay
Price fluctuations	President	The marketing price of paddy may quickly change
The price is low	President	The marketing price of paddy may be low
Household rice self-sufficiency	Producer	I don't know if I my production will be sufficient to feed the household until next harvest

Figure 2: Multiple Component Analysis of non-contracted farms



[59] In Wolof or Peulh, depending on the language best spoken by the respondent.

1.3. Appendices - Chapter 4

Figure 2: Overlap chart for marketing contract

(The control group comprises producers who used a CNCAS loan and sold through spot transactions)

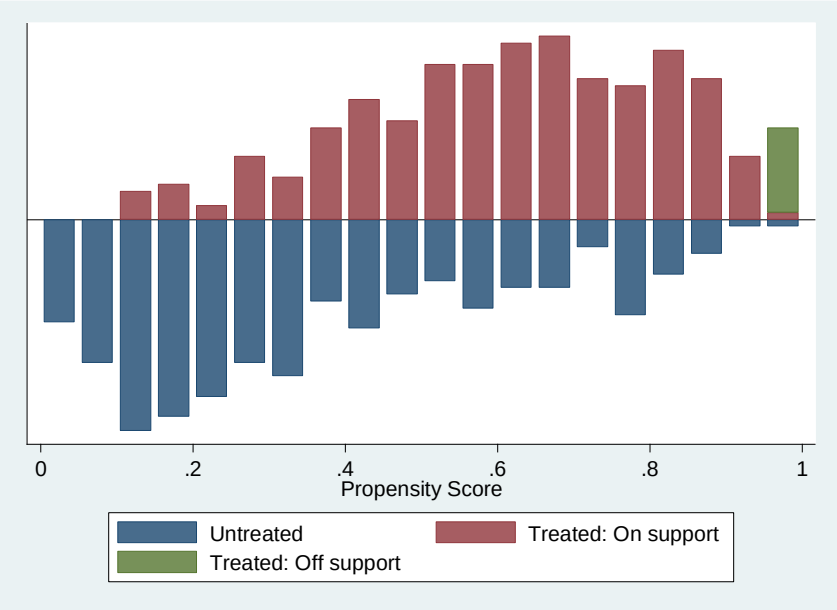


Figure 3: Overlap chart for production contract 1

(The control group comprises producers who had no CNCAS loan and did not grow rice)

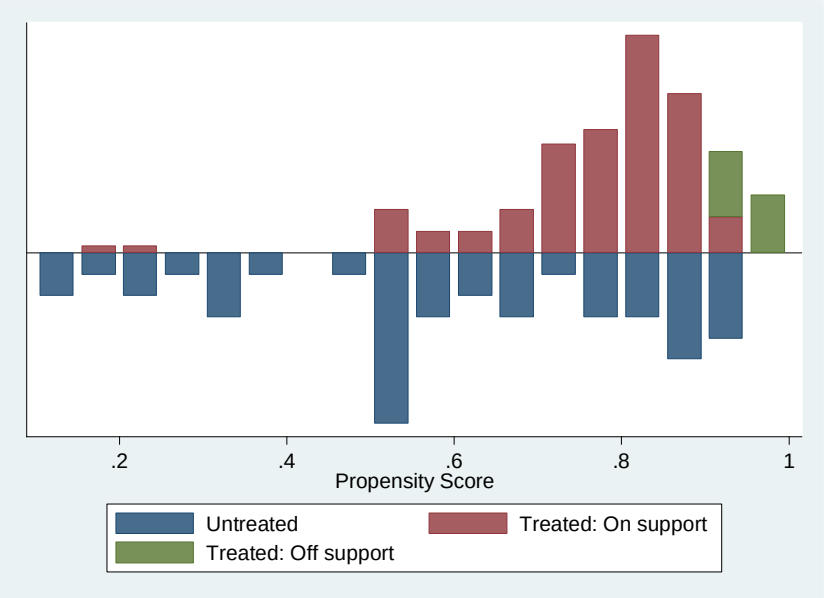


Figure 4: Overlap chart for production contract 2

(The control group comprises producers who used a CNCAS loan and sold through spot transactions)

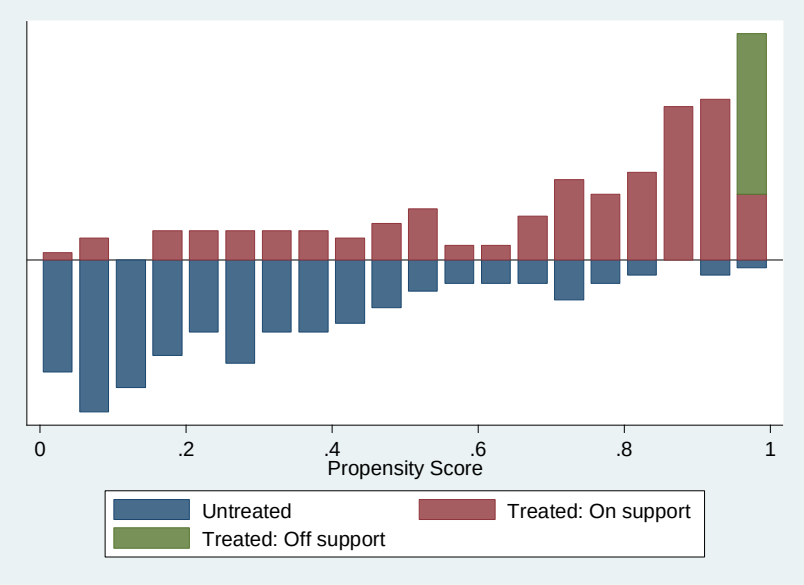


Table 7: Balancing of covariates before and after matching for producers engaged in marketing contracts

Marketing contract (the control group comprises producers who used a CNCAS loan and sold through spot transactions)

Sample		Mean		%bias	% bias reduction	t-test		V(T) / V(C)
		Treated	Control			t	p>t	
Developed area	Unmatched	1.5393	1.2938	22.9		1.88	0.061	0.72
	Matched	1.5614	1.5228	3.6	84.3	0.30	0.761	0.88
Number of active members	Unmatched	3.1462	2.2908	71.8		5.94	0.000	1.86*
	Matched	3.0945	2.9449	12.6	82.5	0.96	0.340	1.29
Experience in rice growing	Unmatched	19.077	18.05	11.5		0.94	0.347	0.58*
	Matched	19.079	19.494	-4.7	59.5	-0.34	0.731	0.48*
Age of head of household	Unmatched	49.762	47.631	19.2		1.57	0.117	0.82
	Matched	49.945	49.282	6.0	68.9	0.48	0.629	0.88
Value of non-land assets in 2010	Unmatched	1.3e+06	1.1e+06	8.5		0.71	0.479	2.67*
	Matched	1.3e+06	1.3e+06	-0.9	89.5	-0.07	0.944	2.54*
Dependency ratio	Unmatched	.67146	.68937	-11.7		-0.97	0.334	1.29
	Matched	.6742	.68171	-4.9	58.1	-0.40	0.689	1.48*
Female head of household	Unmatched	.01538	.15603	-51.7		-4.19	0.000	.
	Matched	.01575	.02992	-5.2	89.9	-0.75	0.452	.
Ethnic group Wolof	Unmatched	.76154	.58156	38.9		3.19	0.002	.
	Matched	.76378	.74331	4.4	88.6	0.38	0.706	.
Storage outside in 2010	Unmatched	.18462	.29078	-25.0		-2.05	0.041	.
	Matched	.18898	.11811	16.7	33.2	1.57	0.118	.
Degree of specialization of the farm	Unmatched	.63814	.68541	-18.0		-1.48	0.141	0.90
	Matched	.6366	.61639	7.7	57.2	0.59	0.558	0.74
Number of members in the producer organization	Unmatched	40.369	38.499	4.1		0.34	0.736	0.22*
	Matched	40.197	43.789	-8.0	-92.0	-0.93	0.351	0.60*
Perception of uncertainty	Unmatched	1.1769	.63121	91.7		7.52	0.000	0.81
	Matched	1.1732	1.1654	1.3	98.6	0.11	0.913	0.96
Ownership of vehicle in 2010	Unmatched	.64615	.56028	17.6		1.44	0.150	.
	Matched	.6378	.52598	22.9	-30.2	1.81	0.071	.
Distance from miller offering a production contract	Unmatched	30.896	43.014	-65.5		-5.34	0.000	0.36*
	Matched	31.091	25.563	29.9	54.4	2.63	0.009	0.48*

Table 8: Balancing of covariates before and after matching for producers engaged in production contracts 1

Production contract (the control group comprises producers who had no CNCAS loan and did not grow rice)

Sample		Mean		%bias	% bias reduction	t-test		V(T) / V(C)
		Treated	Control			t	p>t	
Developed area	Unmatched	2.7687	1.6112	51.7		2.65	0.009	2.60*
	Matched	2.2908	2.2814	0.4	99.2	0.04	0.971	2.01*
Number of active members	Unmatched	4.1825	3.2558	47.5		2.67	0.008	1.07
	Matched	4.6222	4.8267	-10.5	77.9	-0.69	0.492	0.91
Experience in rice growing	Unmatched	18.325	21.349	-26.9		-1.70	0.092	0.43*
	Matched	19.3	19.996	-6.2	77.0	-0.45	0.653	0.50*
Age of head of household	Unmatched	48.905	51.047	-19.2		-1.11	0.267	0.82
	Matched	49.444	50.364	-8.3	57.0	-0.53	0.596	0.63*
Value of non-land assets in 2010	Unmatched	1.8e+06	3.1e+06	-17.2		-1.31	0.191	0.05*
	Matched	1.9e+06	2.5e+06	-7.1	59.0	-1.62	0.108	1.73*
Dependency ratio	Unmatched	.55472	.59521	-20.2		-1.11	0.268	1.29
	Matched	.53608	.53368	1.2	94.1	0.09	0.928	2.27*
Female head of household	Unmatched	.01587	.04651	-17.5		-1.14	0.256	.
	Matched	.01111	.000	6.4	63.7	1.00	0.319	.
Ethnic group Wolof	Unmatched	.61905	.74419	-26.9		-1.49	0.139	.
	Matched	.67778	.64444	7.2	73.4	0.47	0.639	.
Storage outside in 2010	Unmatched							
	Matched							
Degree of specialization of the farm	Unmatched	.69581	.73963	-19.7		-1.05	0.294	1.63*
	Matched	.69854	.65472	19.7	-0.0	1.17	0.244	0.90
Number of members in the producer organization	Unmatched	20.087	36.93	-55.0		-3.24	0.001	0.74
	Matched	21.878	31.689	-32.1	41.7	-2.27	0.024	0.84
Perception of uncertainty	Unmatched	1.0873	3.0698	-193.4		-13.78	0.000	0.15*
	Matched	1.2333	1.1111	11.9	93.8	2.00	0.047	1.55*
Ownership of vehicle in 2010	Unmatched	.65079	.67442	-5.0		-0.28	0.780	.
	Matched	.73333	.83333	-21.0	-323.3	-1.63	0.105	.
Distance from miller offering a production contract	Unmatched	27.004	37.814	-52.4		-3.54	0.001	0.25*
	Matched	28.333	29.901	-7.6	85.5	-0.74	0.461	0.51*

Table 9: Balancing of covariates before and after matching for producers engaged in production contracts 2

Production contract (the control group comprises producers who used a CNCAS loan and sold through spot transactions)

Sample		Mean		%bias	% bias reduction	t-test		V(T) / V(C)
		Treated	Control			t	p>t	
Developed area	Unmatched	2.7106	1.2938	70.9		6.00	0.000	4.98*
	Matched	2.2713	2.6134	-17.1	75.9	-1.45	0.147	0.82
Number of active members	Unmatched	4.1613	2.2908	121.7		10.31	0.000	3.76*
	Matched	3.8913	3.1623	47.4	61.0	4.08	0.000	2.33*
Experience in rice growing	Unmatched	18.239	18.05	2.0		0.17	0.863	0.77
	Matched	17.949	17.92	0.3	84.7	0.02	0.983	0.38*
Age of head of household	Unmatched	48.445	47.631	7.3		0.63	0.532	0.85
	Matched	48.754	49.164	-3.7	49.6	-0.29	0.773	0.73
Value of non-land assets in 2010	Unmatched	1.8e+06	1.1e+06	35.5		3.02	0.003	2.37*
	Matched	1.8e+06	2.0e+06	-9.5	73.4	-0.70	0.485	1.19
Dependency ratio	Unmatched	.57125	.68937	-66.7		-5.68	0.000	2.09*
	Matched	.58008	.64748	-38.1	42.9	-2.99	0.003	1.55*
Female head of household	Unmatched	.01935	.15603	-49.6		-4.34	0.000	.
	Matched	.02174	.03188	-3.7	92.6	-0.52	0.603	.
Ethnic group Wolof	Unmatched	.64516	.58156	13.0		1.12	0.263	.
	Matched	.65217	.66957	-3.6	72.7	-0.30	0.761	.
Storage outside in 2010	Unmatched	.1871	.29078	-24.4		-2.11	0.036	.
	Matched	.18841	.12899	14.0	42.7	1.35	0.178	.
Degree of specialization of the farm	Unmatched	.70634	.68541	8.0		0.69	0.491	0.88
	Matched	.706	.7766	-27.0	-237.2	-2.33	0.020	1.05
Number of members in the producer organization	Unmatched	20.045	38.499	-40.8		-3.56	0.000	0.23*
	Matched	21.594	28.123	-14.4	64.6	-2.19	0.029	1.98*
Perception of uncertainty	Unmatched	1.0903	.63121	78.6		6.78	0.000	0.74
	Matched	1.058	1.2	-24.3	69.1	-2.25	0.000	0.99
Ownership of vehicle in 2010	Unmatched	.67097	.56028	22.8		1.96	0.050	.
	Matched	.66667	.63188	7.2	68.6	0.60	0.547	.
Distance from miller offering a production contract	Unmatched	28.129	43.014	-81.4		-7.08	0.000	0.33*
	Matched	28.551	22.289	34.3	57.9	3.31	0.001	0.58*

Table 10: Models for producers engaged in marketing contracts

	Marketing contract (the control group comprises producers who used a CNCAS loan and sold through spot transactions)[60]								
	Contract only		Contract plus spot		Production			Food security	
	Profit (FCFA/kg)	Price (FCFA/kg)	Profit (FCFA/kg)	Price (FCFA/kg)	Yield (kg/ha)	Production cost (FCFA/kg)	HFIAS total	HFIAS quantity	HFIAS quality
Marketing contract	-13.761	3.354535	-12.58946	4.526075	-141.7626	17.11554	-2.67752*	-1.474431**	-1.235247
Developed area	1.063329	-.7665388**	.8954336	-.934433***	-82.04707	-1.829867	-.2315328	.0267236	-.1903147
Number of active members	-.0870774	-.7373546	-1.400299	-2.05057***	69.10595	-.6502773	-.3637219	-.0674076	-.1261801
Experience in rice growing	-.1880197	-.0018043	-.2127569	-.0265415	-26.73763	.1862155	-.0202681	-.0033113	.0034373
Age of head of household	.2220514	.1098686***	.102235	-.0099477	-5.63059	-.1121828	.0000454	.0039356	-.0186725
Value of non-land assets in 2010	1.80e-07	-3.00e-07***	-2.46e-07	-7.26e-07***	.0001433***	-4.80e-07	1.04e-07*	2.61e-09	1.32e-07*
Dependency ratio	-1.795443	5.923198	-12.60583	-4.887186	-1221.713	7.718641	-5.0014**	-1.609415**	-2.945598*
Female head of household	-15.29461	4.585855	-17.70942	2.171041	-308.0151	19.88046*	.9831457	.6271687	.3005376
Ethnic group Wolof	1.394092	.8831433	-2.522415	-3.033363**	306.6147	-.5109485	.4772614	.3942123**	.1402542
Storage outside in 2010	4.881235	14.44108***	5.812663	15.3725***	-270.7357	9.559841***	5.2209***	-.508519***	5.587131*
Degree of specialization of the farm	8.251128	2.168116	6.50115	.4181375	520.9122	-6.083013	1.26154	.5610717*	.3651419
Number of members in the producer organization	-.071748*	-.0141305	-.0448335	.0127842	-13.3296***	.0576177	.0122072	.0068292*	.003969
Ownership of vehicle in 2010	-4.409051	.9560971	-4.980661*	.3844869***	-414.1438**	5.365148*	-.5999053	-.011859	-.6390921*
Constant	47.40149	112.9638***	68.1998***	137.4344***	8285.575***	65.56233***	9.4030***	1.839797***	6.54922***
Prob > chi2	0.0041	0.0000	0.0003	0.0000	0.0000	0.0026	0.0000	0.0341	0.0000
Adjusted R2 (centered R2)	0.0801	0.4558	0.1145	0.3702	0.2164	-0.0016	0.4007	0.1427	0.5443
Endogeneity test of treatment variable	1.152	0.418	0.835	3.219*	0.068	1.143	0.133	0.451	0.441
Weak identification test (Cragg-Donald Wald F statistic):					17.337				
Underidentification test (Anderson canon. corr. LM statistic):					16.938***				
Number of observations					271				
Instruments					Uncertainty perception				

[60] Results from IV models. Significant levels indicated as *p<.1; **p<.05; ***p<.01. Source: survey data.

Table 11: Models for producers engaged in production contracts 1

	Production contract (the control group comprises producers who had no CNCAS loan and did not grow rice)[61]								
	Contract only		Contract and spot		Production			Food security	
	Profit (FCFA/kg)	Price (FCFA/kg)	Profit (FCFA/kg)	Price (FCFA/kg)	Yield (kg/ha)	Production cost (FCFA/kg)	HFIAS total	HFIAS quantity	HFIAS quality
Production contract	28.54972***	104.0937***	33.46544***	109.0094***	7054.721***	75.54394***	-2.43623***	-1.44277***	-.7173968*
Developed area	-.6749057	-.2386481**	-.7405939	-.3043364*	-97.69797**	.4362576	.0945953	.0235531	.0364234
Number of active members	.3319335	.131	.0113214	-.1896122	99.3796	-.2009335	-.549488**	-.0885144	-.2932401**
Experience in rice growing	.1062329	.0237615	.1246136	.0421422	12.68711	-.0824714	.0850932**	.0321605	.0493873**
Age of head of household	.1399423	.0077101	.1869471	.054715	-3.536397	-.1322322	-.131450***	-.054872***	-.067618***
Value of non-land assets in 2010	2.05e-08	4.43e-08	2.86e-08	5.24e-08	3.32e-06	2.38e-08	-1.49e-07**	-5.14e-08*	-7.52e-08**
Dependency ratio	7.322942	-.8144341	3.794861	-4.342515*	413.7808	-8.137377	.1803845	.6874462	-.3944428
Female head of household	7.520235	5.244606***	7.044302	4.768673**	404.1041	-2.275629	1.941572	1.417176	.5177717
Ethnic group Wolof	1.419745	-.4095942	.8491333	-.9802059	152.8875	-1.829339	.7432996	.4914218	.2013639
Storage outside in 2010	-15.0219***	-2.29475***	-13.1935***	-.4663839	-975.413***	12.72717***	1.842492**	.12465	1.2996***
Degree of specialization of the farm	-7.463343	-1.575394	-8.316533	-2.428584	-658.3929	5.887949	1.532713	-.1347627	1.375545*
Number of members in the producer organization	.0022165	-.031887***	-.002076	-.0361796**	-.9087447	-.0341036	-.0177132	.005687	-.018090***
Ownership of vehicle in 2010	.7324436	-.1018364	.9521599	.1178798	-3.526922	-.83428	-.3762631	-.1332735	-.1526027
Constant	-10.2893	1.876337	-8.768663	3.396975	-122.7827	12.16564	12.34174***	3.849435***	6.481476***
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
Adjusted R2	0.2623	0.9931	0.2948	0.9877	0.8264	0.7774	0.2024	0.1319	0.2147
Number of observations	198								

[61] Results from ordinary least square models. Significant levels indicated as *p<.1; **p<.05; ***p<.01. Source: survey data

Table 12: Models for producers engaged in production contracts 2

	Production contract (the control group comprises producers who used a CNCAS loan and sold through spot transactions)[62]								
	Contract only		Contract and spot		Production		Food security		
	Profit (FCFA/kg)	Price (FCFA/kg)	Profit (FCFA/kg)	Price (FCFA/kg)	Yield (kg/ha)	Production cost (FCFA/kg)	HFIAS total	HFIAS quantity	HFIAS quality
Production contract	-23.1003***	-25.0308***	-17.441***	-19.3714***	-112.8788	-1.930484	1.909277	1.953949	-2.066642
Developed area	-.8197216*	-.3184261*	-.8749784*	-.373683**	-110.6257**	.5012955	.0833698	.0562556	.0251445
Number of active members	.0285617	-.0278165	-.3474119	-.4037901	87.96533	-.0563782	-.5511974**	-.1178903	-.2246498
Experience in rice growing	.1655855	.0393973	.1936971	.067509	17.27529	-.1261882	.0254461	.0184339	.0069252
Age of head of household	.2073743	.0225895	.2596359	.0748511*	-1.509074	-.1847848	-.108863***	-.036680**	-.060360***
Value of non-land assets in 2010	8.48e-08	2.15e-07	1.03e-07	2.34e-07	8.68e-06	1.31e-07	-1.77e-07*	-7.26e-0**	-8.08e-08
Dependency ratio	5.915423	-2.520755	1.684447	-6.75173	471.7806	-8.436178	-1.393144	-.1888841	-1.077189
Female head of household	-.8429806	5.049542	-.377035	5.515488	-173.5602	5.892523	3.159375**	1.389957*	.9526086
Ethnic group Wolof	1.498235	-.6866021	.9666092	-1.218228	135.0476	-2.184837	.4176175	.2955983	.099722
Storage outside in 2010	-11.6617***	-.4978625	-10.05474**	1.109092	-781.396***	11.16383**	2.187612***	.1883523	1.59865***
Degree of specialization of the farm	-6.32225	-1.913562*	-7.015173	-2.606486*	-598.4834	4.408687	1.323848	.0391036	1.28097**
Number of members in the producer organization	-.040049	-.043734***	-.0428171	-.046503***	-4.620957*	-.0036855	-.0043438	.0079033*	-.012021***
Ownership of vehicle in 2010	-.4099117	-.6616364	-.2495583	-.501283	-67.36359	-.2517247	-.9482849	-.4502397*	-.2748091
Constant	39.36515***	132.1637***	40.22002***	133.0186***	6954.212***	92.79859***	9.695069***	.7698943	8.366665***
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0051	0.0157	0.0000	0.0029	0.0000
Adjusted R2 (centered R2)	0.1674	0.7452	0.1245	0.5792	0.1053	0.0882	0.2102	-0.0263	0.3095
Endogeneity test of treatment variable	1.691	1.875	1.417	1.796	1.710	1.267	1.878	3.751*	0.219
Weak identification test (Cragg-Donald Wald F statistic):					28.597				
Underidentification test (Anderson canon. corr. LM statistic):					21.081***				
Number of observations					296				
Instruments					Distance from production contract rice miller				

[62] Results from IV models. Significant levels indicated as *p<.1; **p<.05; ***p<.01. Source: survey data.

Table 13: Critical values of Rosenbaum bounds test for nearest neighbor matching[63]

Marketing contract	Control group comprises producers who used a CNCAS loan and sold through spot transactions	Contract only	Profit (FCFA/kg)	
			Price (FCFA/kg)	
		Contract and spot	Profit (FCFA/kg)	
			Price (FCFA/kg)	1,25**
		Production	Yield (kg/ha)	
			Production cost (FCFA/kg)	
		Food security	HFIAS total	1,48**
			HFIAS quantity	5.0*
			HFIAS quality	
Production contract	Control group comprises producers who did not have a CNCAS loan and did not grow rice	Contract only	Profit (FCFA/kg)	6.1**
			Price (FCFA/kg)	22.6***
		Contract and spot	Profit (FCFA/kg)	6.6**
			Price (FCFA/kg)	21.5***
		Production	Yield (kg/ha)	30.3**
			Production cost (FCFA/kg)	30.3**
		Food security	HFIAS total	4**
			HFIAS quantity	1**
			HFIAS quality	3.7**
	Control group comprises producers who used a CNCAS loan and sold through spot transactions	Contract only	Profit (FCFA/kg)	4,8**
			Price (FCFA/kg)	27**
		Contract and spot	Profit (FCFA/kg)	1,7**
			Price (FCFA/kg)	13,4**
		Production	Yield (kg/ha)	
			Production cost (FCFA/kg)	
		Food security	HFIAS total	
			HFIAS quantity	
			HFIAS quality	

[63] Significant levels indicated as *p<.1; **p<.05; ***p<.01. Source: survey data.

2. **Posters**

Poster 1 : Presentation of chapter 2 at the 149th Seminar of the European Association of Agricultural Economists, Rennes, France, October 27-28, 2016

THE ONGOING MODERNIZATION OF THE RICE VALUE CHAIN IN SENEGAL: A MOVE TOWARD THE ASIAN QUIET REVOLUTION?

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Context

The "Quiet revolution" in Asia (Reardon et al., 2012) reveals the modernization of domestic food chains, brought about by the midstream segment which invests in new technologies and integrates new functions. In Africa, scientific evidence on transformations of domestic value chains is limited.

Objective

We analyze the dynamics of the domestic rice value chain in Senegal, in order to assess if it follows the same trends than in Asia.

Conceptual Framework

The Global Value Chain framework (Gereffi, Humphrey, and Sturgeon, 2005) highlights the influence that one actor in a steering position within the value chain has on the quality of product, and the distribution of tasks and skills among the various partners. Governance is the "authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain". Technical change, understood as the use of new technologies, may steer governance toward integration when it makes transactions more complex. It may also turn governance toward a more relaxed form, when it strengthens the skills of suppliers

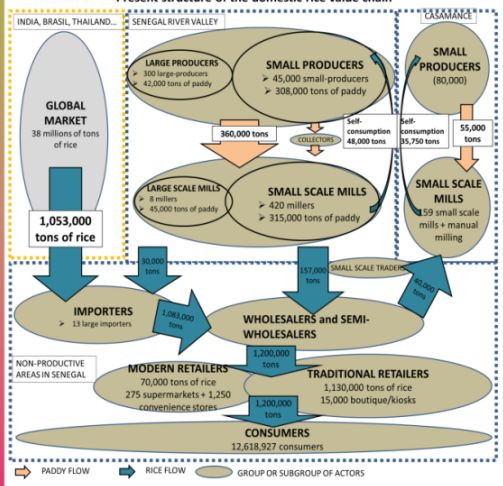
Methodologie

We study the case of the rice value chain from the Senegal River Valley, which seems to provide a good case reflecting the Asian revolution. We carried out 154 in-depth interviews with value chains stakeholders and a quantitative survey dealing with each step of the VC.

Results

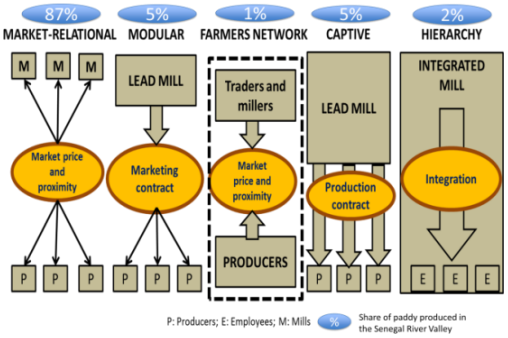
From 1964 to 1994, each level of the value chain was directly or indirectly managed by two State agencies. But this system was not financially sustainable. The liberalization started in 1994 and the dependency on global markets increased. The traditional value chain expanded, with a market governance. Since the first world food crisis, we observe patterns of vertical integration and modernization supported by public policies. Volumes produced doubled and processors invested in technologies producing rice with low rates of impurity.

Present structure of the domestic rice value chain



New modes of coordination are set-up between rice millers and producers. They take into consideration quality of paddy, credit and access to inputs.

Governance modes between producers and processors within the rice value chain



We compared the share of benefits in the final price in 2014 with the results from surveys carried out during the periods of hierarchy and market governance. The modernization increases benefits, particularly in favor of processors.

Comparison of the Asian and Senegalese modernizations

		Asia (Reardon et al., 2012)	Senegal (our data)
Institutional environment	Link to global market	Supplier or independent	Purchaser
	Policies	Support to modernization: infrastructures, subsidies	Support to modernization: subsidies, credit and support to coordination
Organization of the chain	Small-producers	Increase in production	
	Processing	Technical change and concentration	Technical change and expansion
	Retailing	Supermarket revolution	Traditional retailing dominates
	Geographical distance	Increasing	
	Number of intermediaries	Millers integrate the function of collection	Millers already collected the paddy
	Governance	From interlinked transactions to integration Midstream segment is the driver	From market governance to integration. Midstream segment is the driver (with government incentives)
Performance	Volumes	Intermediate and modern VCs dominate in PRC and India and emerge in Bangladesh	Modern VCs provide 12% of domestic production
	Quality	high-quality rice	Medium-quality rice
	Margins	Increase in total net margin and share of midstream segment	

Conclusion

The rice VC is undergoing modernization as described by Reardon et al. (2012a). Nevertheless, the main differences between the Asian and African cases are that in Senegal: (1) the VC is more vulnerable to price shocks from global markets, (2) governance tends towards integration mainly because of credit policies, and (3) the modernization is more advanced in Asia.

We recommend policies to include small scale processors in the modernization of the value chain by supporting their access to compact unit rice millers and opening investment loans by CNCAS, with strong guarantees and insurance.

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Poster 2: Contribution to the intra-Cirad Workshop Value chains and sustainable development

Chantier F&DD

Towards a harmonized framework for assessing the sustainability of agricultural chains: propositions for building a multidisciplinary dialogue

cirad AGRICULTURAL RESEARCH FOR DEVELOPMENT

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Introduction

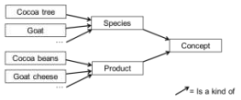
Agricultural chains have been assessed historically using a socio-economic approach often coupled with an agro-technologic one. These two approaches consider the social and the economic dimensions of sustainability but do not account for the environmental impacts. Life Cycle Assessment methods were developed with a focus on evaluating this dimension. To obtain a comprehensive picture of the sustainability, multiple parallel analyses should be done. However, the results so produced are often hard to compare and integrate.

This work intends to address the issue of initiating a fruitful multidisciplinary dialogue and investigating the possibility of integration of these three methods. Its final objective is to bring the different methods as close as possible and to propose a multidisciplinary harmonized framework for assessing the sustainability of agricultural chains.

Material and Methods

Modeling approach and method using 3 types of semantic graph

Vocabulary of concepts



Vocabulary of relations

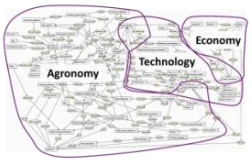
Description of a domain

4 types of meetings

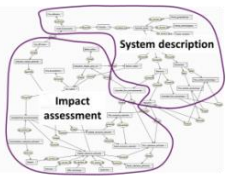
Results – a prototype of the harmonized framework

Description of the 3 domains

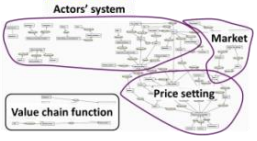
Agro-technology approach



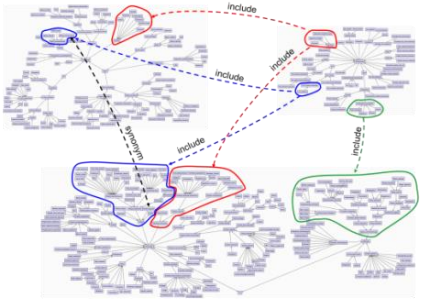
Life Cycle Assessment method



Socio-economy approach



Example of mapping between vocabulary of concepts



Next step

Improve domain descriptions,
Manage polysemy in the vocabulary mapping
Translate concepts and relations (Agrovoc…) to get a multilingual system

Conclusion

The harmonized framework will facilitate the coordination and joint work of experts of different disciplines involved in these assessments and will allow the identification of a harmonized dataset required for the different approaches within the EuropeAid programme "Inclusive and Sustainable Value Chains" (2016-2019). It will also contribute to develop a CIRAD Knowledge Base System devoted more broadly to the investigation of the topic: "agricultural chains & sustainable development" (2016-2019).

> Aknowledgement

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3. Chapter 6: Les effets des investissements d'agrobusiness sur les agriculteurs familiaux. Le cas de la vallée du Fleuve Sénégal

The chapter is under review at Économie Rurale

Soullier, G., Moustier, P., Bourgoin, J., and Ba, A. (En révision) "Gouvernance des chaînes de valeur et gouvernance territoriale : quels effets pour les producteurs de la vallée du fleuve Sénégal ?"

A. Introduction

Durant la crise alimentaire de 2007, l'indice des prix alimentaires mondiaux de la Banque Mondiale a été multiplié par 2.5 (Cuesta et al., 2014). En vue d'améliorer la sécurité alimentaire dans les pays en développement, la FAO, la Banque Mondiale et plusieurs Etats africains ont recentré leurs interventions sur les filières domestiques (Bricas and Daviron, 2009; Dabat et al., 2008). Ces Etats, dont le Sénégal, visent particulièrement à l'autosuffisance en riz (CARD, 2008).

Ces politiques agricoles cherchent à moderniser la production, en soutenant une agriculture entrepreneuriale et en augmentant les rendements (Ribier and Baris, 2013). Elles appuient l'aménagement de superficies irriguées et mettent en place des crédits et subventions aux intrants de synthèse (Lançon and Mendez del Villar, 2013). Elles encouragent aussi des entreprises étrangères à réaliser de grands investissements dans la production et la transformation agro-alimentaire (Gatete and Dabat, 2014; Bauer et al., 2011). Ces entreprises prennent le contrôle hiérarchique de la production (Requier-Desjardins et al., 2015) ou mettent en place des contrats (Hathie, 2016; Soullier and Moustier, 2015; Ribier and Baris, 2013; World Bank, 2013).

Ces investissements sont réalisés sur des territoires où domine une agriculture familiale. Ils peuvent avoir des effets sur l'organisation des territoires et la performance des petits producteurs. Néanmoins, les politiques et travaux de recherche actuels se concentrent plutôt vers la capacité des filières domestiques à satisfaire les besoins alimentaires des consommateurs urbains (Hathie, 2016). Nous cherchons dans cet article à contribuer à la compréhension de deux phénomènes : (1) Comment des investissements d'agrobusiness (AB) dans la production et la transformation agricole influencent la participation des petits producteurs à la gestion des ressources agricoles du territoire ? (2) Quels sont les effets des changements de l'organisation des filières et des territoires sur la performance des petits producteurs ? Nous proposons de répondre à ces questions par l'étude d'investissements dans la vallée du fleuve Sénégal, où le changement d'organisation des filières semble affecter les petits producteurs en termes d'accès au foncier, de revenus, de sécurité alimentaire et de pratiques agricoles (Soullier and Moustier, 2015, 2016).

B. Cadre conceptuel : gouvernance des chaînes de valeur et gouvernance territoriale

Les petits producteurs (ou agriculteurs familiaux) sont caractérisés par la gestion familiale du capital, du travail et de la production, ainsi que la présence d'autoconsommation et un statut juridique parfois non formalisé (Bosc et al., 2015). Ils peuvent participer à une chaîne de valeur traditionnelle, qui est composée de plusieurs intermédiaires faiblement dotés en capital, ou à une chaîne de valeur moderne, qui comprend

des AB. Ces AB sont des entreprises privées, intégrées aux marchés locaux et/ou internationaux, qui mettent en œuvre une agriculture productiviste et/ou des activités de transformation basées sur des moyens de production à fort contenu en capital (Giertz et al., 2013).

Le cadre conceptuel des chaînes de valeur permet d'expliquer les formes plus ou moins intégrées des filières, et leurs effets économiques sur les producteurs (Gereffi et al., 2005). Il établit le lien entre le pilotage de la qualité du produit par la firme dite dominante et la distribution des compétences et de la valeur ajoutée entre les acteurs. La gouvernance de la chaîne de valeur est définie comme les « relations d'autorité et de pouvoir qui déterminent comment les ressources financières, matérielles et humaines sont réparties et circulent au sein de la chaîne » (Gereffi and Korzeniewicz, 1994, p97)[64]. La gouvernance varie entre le marché (aussi appelé transaction spot), où la coordination est réalisée par le prix, et la hiérarchie, où l'approvisionnement est contrôlé par la voie administrative. Des formes intermédiaires concernent des contrats avec implication ou non de l'acheteur dans le processus de production de son fournisseur.

L' « upgrading » (qui peut être traduit par « montée en gamme » ou « mise à niveau ») est le processus d'acquisition de nouvelles capacités et d'accès à de nouveaux marchés par la participation à une chaîne de valeur particulière (Humphrey, 2004). Il peut être provoqué par l'utilisation de nouvelles technologies. La gouvernance tend vers le marché lorsqu'upgrading renforce les compétences des producteurs, par exemple par l'utilisation d'intrants améliorés ou la mise en œuvre de nouvelles techniques agricoles. La gouvernance tend vers la hiérarchie lorsque l'upgrading complexifie les transactions, par exemple lorsqu'il y a détermination de nouvelles caractéristiques de la qualité du produit.

La performance des producteurs dépend non seulement de l'organisation des chaînes de valeur, mais aussi de leurs possibilités d'accès aux ressources agricoles des territoires. Cet accès est influencé par les investissements des AB, qui peuvent être soutenus par les autorités nationales et locales. La gouvernance territoriale est un « processus dynamique de coordination entre des acteurs publics et privés aux identités multiples et aux ressources asymétriques autour d'enjeux territorialisés » (Rey-Valette et al., 2011, p39). Les formes de coordination territoriale dépendent du niveau de participation des différents groupes d'acteurs (Beuret, 2006). Elles varient entre la communication (des acteurs font passer un message concernant une décision) et la négociation (construction commune d'une décision). Ce cadre est dynamique puisque des innovations organisationnelles et institutionnelles peuvent changer ce niveau de participation, notamment lorsqu'elles ont lieu au sein d'une chaîne de valeur.

[64] Traduction des auteurs.

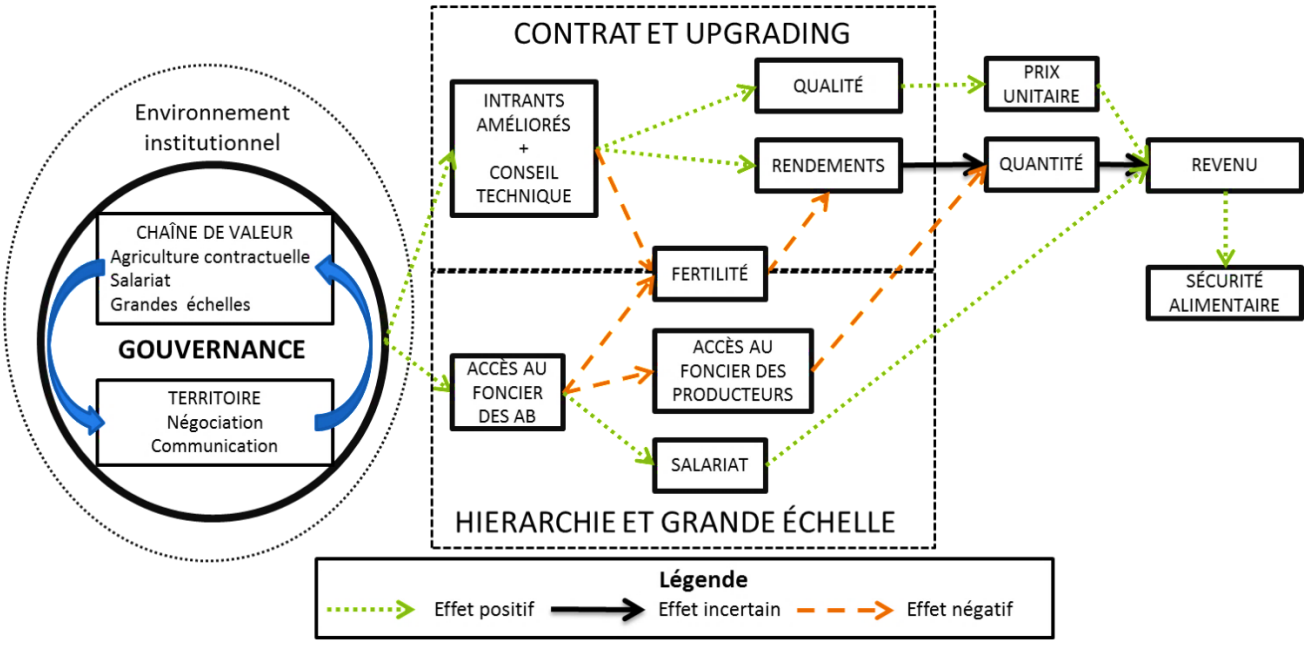
C. Chemins d'impacts

Notre première hypothèse est que les AB sont caractérisés par de la coordination verticale et une grande échelle de production, résultant en une forte pression sur la gouvernance territoriale. L'installation d'AB conduirait donc à une réduction de la participation des petits producteurs dans la gestion des ressources agricoles du territoire (Amanor, 2012; Dell'Angelo et al., 2017).

Notre seconde hypothèse est que ces investissements provoquent une combinaison d'effets dont les aspects positifs et négatifs varient en fonction des types de producteurs. Nous analysons dans cet article les effets sur l'accès au foncier, les revenus, la sécurité alimentaire et les pratiques agricoles (Figure 1).

(1) La combinaison d'investissements à grande échelle et de la tendance vers l'intégration verticale réduit l'accès au foncier des producteurs locaux. La libéralisation et la mise en place de politiques agricoles productivistes, constituent un cadre favorable aux investissements (McMichael, 2012). Cela peut donner lieu à une concurrence dans l'utilisation des ressources foncières entre AB et producteurs familiaux (Amanor, 2012; Brondeau, 2011).
(2) La tendance vers l'intégration verticale améliore les revenus des producteurs familiaux, par le biais de l'agriculture contractuelle et du salariat. L'agriculture intégrée, dont l'agriculture contractuelle, est une innovation institutionnelle qui compense les défaillances des marchés des facteurs de production et des produits agricoles (Swinnen and Maertens, 2007). Les contrats provoquent l'upgrading des petits producteurs inclus, en leur permettant d'accéder à des intrants améliorés et à des conseils techniques (Reardon et al., 2009). D'autre part, le contrôle hiérarchique de la production agricole améliore les revenus des petits producteurs par le biais du marché du travail, notamment pour les plus pauvres (Van den Broeck et al., 2017).
(3) L'agriculture contractuelle a un effet positif sur la sécurité alimentaire par le biais du revenu (Bellemare and Novak, 2017).
(4) Ces effets positifs pourraient ne pas durer dans le temps puisque l'intensification de la production agricole peut aboutir à la réduction de la fertilité des sols et des rendements, en particulier lorsqu'une entreprise recherche une rentabilité de court terme (Glover et al., 2014; Swain, 2011; Opondo, 2000).

Figure 1 : Chemins d'impacts identifiés dans la littérature



Source : revue de la littérature citée ci-dessus

Néanmoins, les investissements d'AB ont des effets qui varient en fonction des types de producteurs. Par exemple, des investissements dans la production d'agrocarburants à Madagascar ont des effets négatifs sur les revenus et l'accès au foncier des grands agriculteurs et des éleveurs, et positifs pour les petits producteurs et les migrants, notamment par le biais du salariat (Medernach and Burnod, 2013).

D. Méthode : une approche mixte

Le terrain d'étude est le département de Dagana dans la vallée du fleuve Sénégal, qui concentre l'essentiel des périmètres irrigués du Sénégal (FAO, 2016), et où vivent 45000 petits producteurs. Trois chaînes de valeur, dont la production et parfois la transformation sont réalisées sur ce territoire, sont concernées par des investissements récents d'AB en lien avec des politiques publiques (Van den Broeck et al., 2017; Soullier and Moustier, 2015; Actionaid, 2014). La chaîne de valeur du riz est la principale cible des politiques agricoles visant à l'autosuffisance (MA, 2009). Les politiques encouragent aussi les investissements d'AB dans les chaînes de valeur de produits maraîchers et d'agrocarburants, notamment par la présentation d'opportunités pour des fonds étrangers (APIX, 2013). Nous n'étudions pas les chaînes de valeur du sucre et du lait, qui sont moins soutenues par les politiques publiques (Diarra et al., 2013).

Nous avons réalisé 154 entretiens semi-directifs avec des acteurs des chaînes de valeur et des agents de développement et de la recherche. L'objectif était d'analyser le changement de l'organisation des chaînes

de valeur et du territoire. Les questions abordées étaient l'organisation des chaînes de valeur et du territoire, les politiques publiques, les comportements d'acteurs, la gestion de la technologie et la qualité des produits.

Nous avons analysé les interrelations entre trois AB récemment implantés et les petits producteurs du territoire. Les AB ont été sélectionnés de manière raisonnée, sur le critère de la diversité des formes apparentes de coordination avec les producteurs (contrats et salariat). 332 petits producteurs situés à proximité des AB ont été aléatoirement sélectionnés et enquêtés[65]. Cette enquête réalisée en 2015 traite des caractéristiques des producteurs et de leurs liens avec les AB.

Un atelier participatif a été réalisé afin de discuter des modalités de négociations formelles et informelles ainsi que des compromis liés à l'installation et l'extension d'agro-industries. Cet atelier a regroupé des représentants d'AB, d'agriculteurs et d'éleveurs autour d'une activité de simulation participative de négociation foncière. La simulation est basée sur le jeu de rôle TerriStoriesTM (création de Patrick d'Aquino, Cirad), développé pour discuter des usages et pratiques foncières, et déjà utilisé comme méthode d'enquête au Sénégal (Papazian et al. 2016). Ce type d'atelier permet aux différents participants de discuter les résultats d'enquêtes réalisées au préalable. Il fournit l'opportunité pour chaque acteur de comprendre les logiques des autres et de les discuter. Mieux comprendre les motivations des décisions prises et identifier les acteurs majeurs intervenant dans cette prise de décision nous permet de compléter notre compréhension de la gouvernance foncière locale.

Une seconde enquête concerne les pratiques agricoles. 118 parcelles de riz ont été suivies durant la contre-saison 2016. Ces parcelles ont été sélectionnées aléatoirement à partir de listes fournies par la société nationale d'appui à l'agriculture irriguée (SAED) et par les riziers. 27 parcelles cultivées dans le cadre de contrat de production et 30 parcelles gérées hiérarchiquement par des transformateurs de paddy sont comparées avec 61 parcelles cultivées par des producteurs financés par la banque nationale et commercialisant leur paddy par des transactions spots. Les indicateurs de la durabilité des pratiques agricoles sont les quantités d'azote et de phosphore, la fréquence des traitements en herbicide, la fréquence des labours, la rotation des cultures et des jachères et l'utilisation de résidus de récoltes.

[65] 100 producteurs pour l'étude du cas de l'AB *Coumba Nor Thiam*, 133 pour l'AB *West African Farm* et 99 pour l'AB *Senhuile- Senethanol*.

Nous présentons aussi les résultats de précédentes recherches réalisées dans le but d'estimer l'impact des contrats sur les revenus et la sécurité alimentaire des producteurs (Soullier and Moustier, 2016). La base de données des organisations de producteurs ayant cultivé en contre-saison 2014 a été stratifiée par modes de vente. 607 producteurs ont été sélectionnés aléatoirement et enquêtés[66]. Les indicateurs de revenu sont le prix de vente et la marge nette[67] par kilogramme. L'indicateur de sécurité alimentaire est le *Household Food Insecurity Access Scale,* qui mesure la perception des répondants quant à la dimension accès de la sécurité alimentaire.[68] Les impacts de la coordination verticale sont estimés par deux modèles économétriques. La méthode de la variable instrumentale[69] corrige l'endogénéïté issue d'une causalité inverse ou de variables omises (Bellemare and Novak, 2017). L'appariement au score de propension évalue l'impact comme la différence de performance entre les producteurs impliqués dans un mode de coordination intégré et les producteurs (aux mêmes caractéristiques) qui vendent par le marché[70].

Tableau 1 : Méthodes, échantillons et indicateurs de la collecte de données

	Gouvernance des chaînes de valeur et du territoire	Accès au foncier	Revenu	Sécurité alimentaire	Pratiques agricoles
Méthodes	Entretiens semi-structurés	Etudes de cas par enquête	1 atelier participatif	Enquête et évaluation d'impact	Enquête et statistiques descriptives
Echantillons	154 entretiens	3 AB 332 petits producteurs	Panel multi-acteurs de 34 personnes	Enquête auprès de 607 producteurs	Suivi de la culture de 118 parcelles
Indicateurs	Politiques publiques, coordination des acteurs, technologies, qualité des produits	Caractéristiques des producteurs Liens avec les AB Foncier utilisé	Propositions/ Demandes de contreparties /compensations	Prix de vente et profit par kg	Household Food Insecurity Access Scale	Quantités d'intrants, fréquences des traitements, intensité culturale et utilisation de résidus

[66] 265 producteurs vendant par transactions spots, 130 producteurs vendant par contrat de commercialisation, 155 producteurs vendant par contrat de production et 44 n'ayant pas cultivés de riz du fait de l'absence de crédit.

[67] Nous déduisons aussi l'amortissement du capital et les coûts d'opportunités. Les coûts d'opportunités sont définis en fonction de l'existence d'un marché pour le facteur de production considéré durant la période de la saison pendant laquelle il est utilisé (Boussard, 1987).

[68] Neuf questions appréhendent cette dimension. Le répondant dispose de trois options de fréquence. Le score varie entre 0 et 27.

[69] Les instruments sont la distance au rizier le plus proche proposant un contrat de production et la perception des producteurs quant à l'incertitude portant sur leur capacité à financer la culture du riz et à satisfaire leurs besoins alimentaires.

[70] La validité des hypothèses d'indépendance conditionnelle et de support commun est vérifiée (Rosenbaum and Rubin, 1983).

E. Résultats

E. 1 Avant la crise des prix

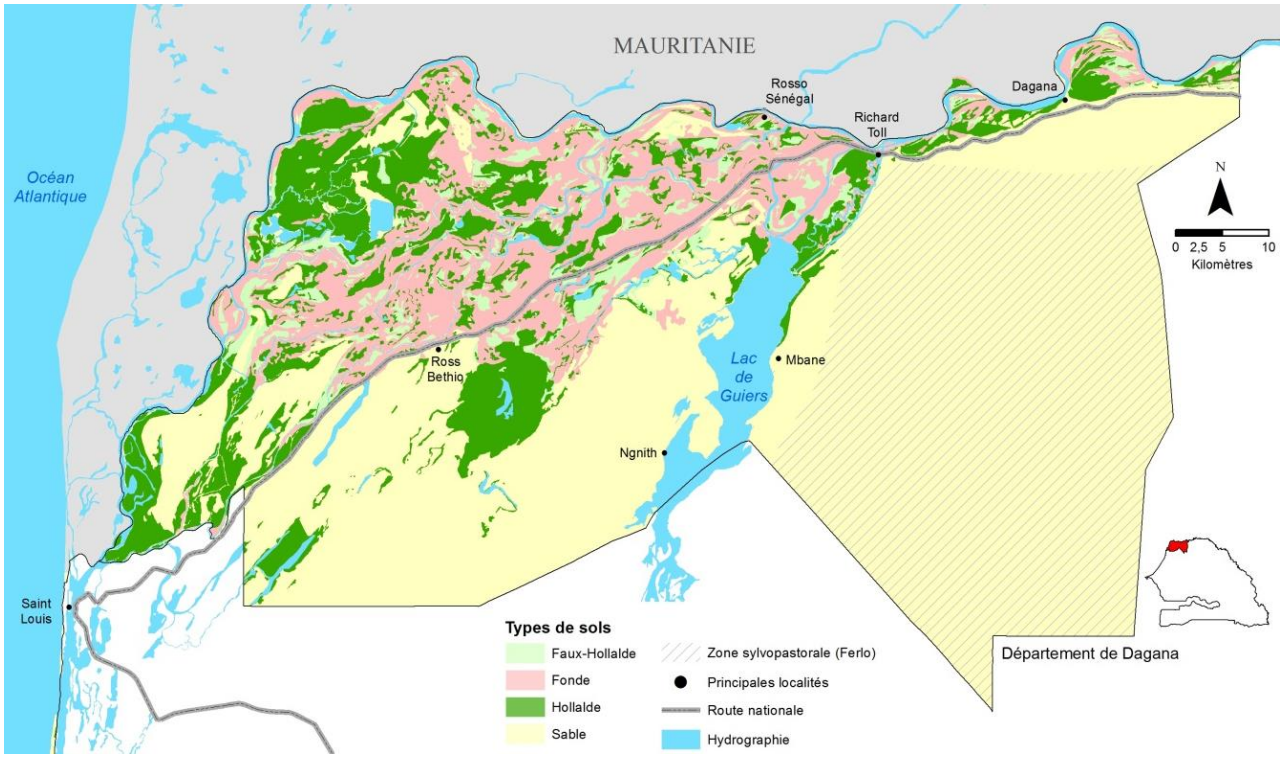
E.1.1 Gouvernance des filières

Entre la mise en œuvre des ajustements structurels (1987) et la crise des prix (2007), les riziculteurs commercialisaient le paddy par des transactions spots, incluant une proximité relationnelle avec l'acheteur (Soullier and Moustier, 2015). La technique utilisée ne réalisait que le décorticage, ce qui générait un riz comportant des impuretés (Demont and Rizzotto, 2012). Les producteurs d'oignons étaient quant à eux impliqués dans une filière dans laquelle se posaient des enjeux de qualité du produit (Diouf, 2014). Par contre, la filière de la tomate était déjà caractérisée par l'existence d'un AB, créé en 1965 (Diouf, 2016).

E.1.2 Gouvernance territoriale

Dans le département de Dagana, les principales ressources relatives à l'agriculture sont le foncier agricole, les espaces de pâturage, l'eau servant à l'irrigation et à l'abreuvement du bétail, et les ressources naturelles végétales (Koopman, 2009). Le département comprend trois zones agro-écologiques (Figure 2). Le Walo est composé de terres humides proches du fleuve et favorables aux cultures irriguées sur des sols sableux (Fonde), argileux (Hollarde) et intermédiaires (Faux hollarde). Le Diéri est traversé par le lac de Guiers et comprend des sols sablonneux éloignés du fleuve. Le Ferlo, ou zone sylvo-pastorale, est la zone où est réalisé l'élevage. Ainsi, les producteurs spécialisés dans la production de riz sont localisés dans le Walo, ceux réalisant du maraîchage (et parfois du riz) sont principalement localisés dans le Diéri et les agropasteurs sont localisés dans le Ferlo.

Figure 2. Pédologie du département de Dagana



Le système foncier sénégalais se caractérise par sa complexité et sa diversité, en raison de la coexistence de régimes coutumiers et du régime foncier légal. La loi du domaine national classe sous zones de terroirs les terres qui sont utilisées pour l'habitat rural, la culture ou l'élevage, et sous zones classées les réserves écologiques et forestières (JO, 1964). Le conseil municipal gère l'affectation des zones de terroirs, sous l'autorité de l'Etat. Il définit le plan d'occupation du sol et est consulté à propos des projets de développement, d'aménagement ou de mise en valeur du terroir. L'Etat gère les zones classées (JO, 1964). Toutefois, cette organisation légale est parfois en désaccord avec les règles et pratiques coutumières. Variable selon les régions et les ethnies, le système coutumier fait la promotion d'une propriété foncière collective, indivisible et inaliénable, où la descendance hérite du droit d'usage et du patrimoine familial. Il résulte que les institutions coutumières et légales peuvent attribuer des fonctions opposées à un même espace.

Depuis l'indépendance du pays, la SAED met en œuvre la politique agricole dans la vallée du fleuve Sénégal. Elle appuie depuis 1973 les agriculteurs dans la mise en œuvre d'une agriculture intensive, basée sur des intrants de synthèse (Ngom et al., 2016; Le Gal, 1995). Elle a aménagé près de 30000 hectares jusqu'en 1987 (Bélières and Touré, 1999). Elle joue aussi le rôle de structure d'appui dans la mise en place des plans d'occupation et d'affectation des sols.

La politique de libéralisation a été mise en œuvre à partir de 1987. Elle a favorisé le désengagement de la SAED de l'accompagnement au développement rural, ainsi que le développement de périmètres privés aménagés par des promoteurs individuels ou organisés en groupements d'intérêt économique. La Caisse Nationale du Crédit Agricole du Sénégal (CNCAS) a aussi été créée en 1987. Elle appuie par le crédit bancaire le développement de l'agriculture dans la vallée du fleuve Sénégal. Toutefois, elle rencontre des difficultés de remboursement de ses crédits, et exclut les organisations de producteurs qui sont endettés (Fall, 2006; Bélières and Touré, 1999).

E. 2 Après la crise des prix

E.2.1 Changement de politiques publiques

Depuis la mise en œuvre des ajustements structurels, les politiques publiques ont favorisé des approvisionnements alimentaires à partir des marchés internationaux, en particulier pour le riz. Mais suite à la crise alimentaire de 2007, le gouvernement du Sénégal a mis en place une grande offensive pour la nourriture et l'Abondance (MA, 2008). Cette politique vise à augmenter la production agricole nationale. Les leviers techniques de l'intensification sont l'accès aux engrais de synthèse, les semences améliorées, la mécanisation agricole et l'aménagement de surfaces irriguées. Ces mesures sont accompagnées par la mise en place de crédits de campagne et de subventions pour les engrais. Le lancement de cette politique a favorisé une multiplication des affectations de terres à des sénégalais. Les investissements étrangers sont aussi encouragés, par le biais de l'agence chargée de la promotion de l'investissement et des grands travaux (APIX). Le programme d'accélération de la cadence de l'agriculture sénégalaise encourage la coordination entre les AB et les agriculteurs familiaux (APIX, 2013; D'Aquino and Seck, 2013). Le riz est la principale cible de ces politiques (MA, 2009). Sont aussi concernés l'oignon, l'arachide et les fruits et légumes (MA, 2014).

E.2.2 Changement de gouvernance des chaînes de valeur

La filière du riz rencontrait des difficultés de qualité du produit et de remboursement des crédits des producteurs à la banque agricole nationale (Fall, 2006; Bélières and Touré, 1999). Entre 2010 et 2014, huit transformateurs utilisant des techniques réalisant des fonctions telles que le séchage et le tri sont apparues (Soullier and Moustier, 2015). Elles réalisent des formes intégrées de coordination avec les producteurs. Les politiques publiques ont appuyé la mise en place de contrats de commercialisation, intégrant les critères de qualité du paddy (taux d'humidité et d'impureté). Les producteurs fournissent un volume correspondant au montant de leur crédit, et les riziers payent directement la banque. Des riziers ont aussi mis en place des contrats de production, dans lesquels ils fournissent des intrants et conseils techniques aux producteurs, et

sont remboursés en paddy. Chaque type de contrat représentait 5% des volumes produits durant la contre-saison 2014. De plus, quatre rizeries contrôlaient hiérarchiquement la culture de 1500 ha.

La filière domestique de la tomate rassemblait en 2015 trois entreprises industrielles de transformation s'approvisionnant par le biais de contrats (Diouf, 2016). Cette filière rencontre des difficultés face à la croissance des importations de triple concentré. En parallèle, on observe une croissance des investissements dans la production horticole dans le but d'exporter sur les marchés européens (Van den Broeck et al., 2017). Cinq entreprises de capitaux étrangers sont apparues à partir de 2005. Elles produisent de la tomate, des haricots et des mangues. Elles emploient 5000 employés dans les champs et unités de conditionnement.

L'entreprise Senhuile-Senethanol a investi dans la production à grande échelle mais la nature de ses cultures reste incertaine (Actionaid, 2014). L'objectif premièrement annoncé était la production de tournesols devant être transformés en biocarburants. Néanmoins, l'entreprise oriente progressivement ses activités vers la production de maïs et de riz.

E.2.3 Changement de la gouvernance territoriale

L'étude de trois AB révèle des insertions territoriales différentes (tableau 2). L'entreprise Coumba Nor Thiam fut créée en 1987 dans le nord du département, ou sont localisés des producteurs spécialisés dans le riz. Elle a progressivement investi dans la production, la mécanisation agricole et la transformation, parfois avec l'appui d'agences de développement (D'Aquino and Seck, 2014). En 2014, elle a cultivé 1000 hectares, réalisé des contrats de production avec 660 producteurs et a transformé 9600 tonnes de paddy. 76% des exploitations localisées dans le même village que l'entreprise ont réalisé un contrat de production avec celle-ci, et 2% ont un membre du ménage qui travaille pour l'entreprise en tant que salarié. L'accroissement des surfaces directement cultivées et contractualisées a permis à l'entreprise d'augmenter son influence sur le foncier. Elle dispose désormais d'une station de pompage.

West African Farms s'est implanté en 2011 dans la commune de Ngnith, à proximité du lac de Guiers, où sont localisés des producteurs diversifiés. Le contrat d'exploitation signé avec le président du conseil rural prévoit la mise à disposition de 200 ha pour que l'entreprise réalise du maraîchage. En contrepartie, cette dernière devait prioriser des embauches dans la commune, contribuer à son budget, et construire un canal permettant l'irrigation de 200 ha pour les producteurs (Commune Rurale de Ngnith, 2011). En 2015, 9.02% des producteurs enquêtés travaillaient comme salarié pour l'entreprise. L'aménagement des parcelles, qui devait être fait par les producteurs, n'avait été réalisé que sur 100 ha. En effet, les règles d'attribution des

parcelles aux producteurs n'avaient pas été précisées dans le contrat d'exploitation. L'entreprise ne s'approvisionne pas auprès de producteurs du département.

Senhuile-Senethanol est une entreprise italo-sénégalaise qui a été en conflit avec la population de la commune de Fanaye, en amont dans la vallée du fleuve Sénégal, à propos de son implantation. Deux décrets présidentiels lui ont attribué 20000 hectares de la réserve naturelle de Ndiael, à l'ouest du lac de Guiers (Actionaid, 2014). Les cultures de l'entreprise rentrent en conflit avec l'élevage et la culture non-irriguée de 9000 agropasteurs, car ces derniers réalisent leurs activités dans la réserve depuis plusieurs décennies. Ils utilisent des terres non-immatriculées, où il est illégal de cultiver selon la loi foncière nationale (Re:common, 2015; Kamara, 2014). 16.16% d'entre eux rapportent l'accaparement de terres qu'ils cultivaient avant l'arrivée de l'entreprise. Les 37 villages affectés par les cultures de Senhuile-Senethanol se sont regroupés dans le but de communiquer auprès des citoyens et d'assurer un suivi de l'occupation des terres (Collectif de Ndiaël et al., 2014). Nénamoins, Senhuile-Senethanol continue l'extension des surfaces cultivées (Actionaid, 2014) bien qu'une décision du gouverneur ait réduit l'affectation des terres à 10000 ha.

Ces trois cas présentent des formes différentes de gouvernance territoriale entre les AB et les petits producteurs. L'entreprise Coumba Nor Thiam est issue du territoire. Elle connaît les institutions locales et dispose d'une proximité avec les producteurs. Parfois avec le soutien d'organisations de développement, elle accroit progressivement son influence sur le foncier et l'eau d'irrigation par le biais de la coordination verticale. L'entreprise Senhuile-Senethanol a été introduite dans le département par le gouvernement Sénégalais, sans prendre en compte la gestion coutumière des ressources naturelles et foncières utilisées par les communautés d'agropasteurs qui vivent dans la réserve sylvo-pastorale déclassée. Les producteurs écartés des négociations cherchent à réintégrer la gouvernance territoriale par le biais de la mobilisation de la société civile et de l'occupation physique des espaces (Chia et al., 2008). L'entreprise West African Farm s'est inscrite dans la gouvernance territoriale par le biais de la négociation avec le conseil communal, en proposant des contreparties contractualisées au profit des producteurs et de la localité, dont un meilleur accès à l'eau d'irrigation. En pratique, la répartition des terres nouvellement irrigables a été source de conflits au sein de la communauté du fait de l'absence de règle d'attribution. A cela s'est ajoutée la difficulté financière de réaliser les aménagements secondaires nécessaires à la mise en culture.

Tableau 2 : Liens entre les agrobusiness et les différents types de petits producteurs

Les acteurs			
Nom de l'AB	Senhuile-Senethanol	West African Farm	Coumba Nor Thiam
Localisation	Ferlo	Diéri	Walo
Types de petits producteurs	Agropasteurs	Producteurs diversifiés	Riziculteurs
Principales sources de revenu	Elevage, cultures-non irriguées	Riz, maraîchage et élevage	Riz
Foncier utilisé	Zones de parcours Surfaces non-immatriculées et non irriguées	Périmètres irrigués collectifs ou privés gérés collectivement	
Ethnie	Peulh	Wolof et Maure	Wolof et Maure
Les liens			
Contrat de production	0%	0%	76%
Emploi salarié	11.1%	9.02%	2%
Location de terre	18.18%	0%	2%
Accaparement de terres	16.16%	1.5%	3%
Aucune relation avec l'AB	54.54%	89.48%	17%

Source : enquête auprès de 332 petits producteurs

E. 3 Effets sur les producteurs

E.3.1 Accès au foncier

L'arrivée d'investisseurs à capitaux étrangers, soutenue par l'Etat sénégalais, a provoqué un changement d'échelle du foncier. Les cessions de terres se sont faites sur de plus larges surfaces, et pour des spéculations parfois vouées à l'exportation. Beaucoup d'affectations portent sur des terres sableuses, dévolues aux pâturages et à l'élevage. Les investisseurs essaient de se conformer à la législation et reçoivent des titres d'affectations par les collectivités locales. Certains réalisent aussi des démarches informelles afin d'assurer leur légitimité auprès des institutions coutumières. Le marché s'organise autour de négociations avec des contreparties qui se matérialisent par des aménagements, la construction d'infrastructures (écoles, mosquées, postes de santé), ou des dons.

L'atelier participatif a mis en évidence cette dynamique et identifié la nature des demandes locales et des propositions de compensations en fonction du contexte. D'une part, l'avancée du front agricole exacerbe les conflits entre agriculteurs et agropasteurs. La question de l'accès à l'eau, notamment au niveau lac de Guiers, est une source de conflit (Papazian et al., 2016). Ces nouvelles formes d'investissements agricoles dans la vallée du fleuve Sénégal ont fait naitre auprès des populations locales et des organisations de la société civile un sentiment d'accaparement des terres par les AB ou des individus nantis. Néanmoins, malgré les critiques envers les AB, la population accepte l'arrivée et l'extension de l'entreprise, du fait de sa

capacité à se substituer aux politiques publiques de développement. Les AB contribuent à l'aménagement rural par des investissements en équipements et dans les infrastructures socio-économiques de base.

E.3.2 Revenus et sécurité alimentaire des riziculteurs

Les modèles économétriques montrent que les contrats de commercialisation n'ont pas d'impact significatif sur les revenus car les petits producteurs engagés dans ces contrats utilisent les mêmes quantités et qualités d'intrants que ceux commercialisant par transactions spots (Soullier and Moustier, 2016). Il résulte une qualité de paddy, un rendement et un prix de vente équivalents à ceux obtenus par les producteurs commercialisant par transactions spots. Le contrat de commercialisation est une innovation institutionnelle qui vise à assurer le remboursement des crédits et les approvisionnements des riziers. Néanmoins, ce contrat réduit légèrement l'insécurité alimentaire car il atténue la saisonnalité des prix. En contre-saison 2014, le prix de vente du contrat de commercialisation a varié de 112.5 FCFA à 137.5 FCFA alors que celui des transactions spots a varié de 83.3 FCFA à 150 FCFA. Ainsi, les producteurs en plus grande insécurité alimentaire remboursent leur crédit durant les six semaines suivant la récolte, quand le prix de vente du contrat est supérieur à celui de la transaction spot. Les quantités conservées sont utilisées pour la consommation alimentaire du ménage.

Le contrat de production est souvent l'unique alternative de crédit pour les producteurs exclus de la banque nationale. Il génère un effet positif sur le revenu de ces producteurs (dont le profit s'élève à 28.5 FCFA/kg) lorsque ces derniers sont comparés aux producteurs ne pouvant pas cultiver de riz par manque de crédit. Cet upgrading a lieu par le biais de l'accès au financement à crédit de la riziculture, mais pas par le biais de l'utilisation d'intrants de synthèse ou de l'accès à du conseil agricole. Néanmoins, les producteurs participant à un contrat de production ont des revenus moins importants que ceux des producteurs bénéficiant d'un crédit de la banque agricole nationale et commercialisant par transaction spot. L'écart de profit est de 15.63 FCFA/kg, soit 38.81%. Cette différence n'est pas due à un écart de rendements mais à une écart de prix de vente. En effet, le contrat de production inclut un taux d'intérêt potentiellement élevé du fait de la structure oligopolistique du segment du marché du crédit des producteurs endettés auprès de la banque. Il inclut aussi une prime d'assurance liée à la caractéristique d'endettement des producteurs. Le prix de vente inclut ces coûts implicites, et pour cela est inférieur de 17.26FCFA/kg par rapport à celui des producteurs financés par la banque nationale.

E.3.3 Pratiques agricoles

A partir de 1973, la SAED a soutenu l'intensification des pratiques agricoles dans la vallée du fleuve Sénégal (Le Gal, 1995). De nos jours, les pratiques agricoles recommandées sont toujours intensives et visent la double culture (Diouf, 2013). La réalisation de contrats de production avec un rizier, et l'intégration verticale de la production, ne fournissent pas un accès à des intrants différents de ceux des producteurs soutenus par la SAED (Tableau 3). Le phosphate diammonique et l'urée sont utilisés par 100% des AB et des producteurs vendant par transactions spots, et par 92,6% des producteurs engagés dans un contrat de production. Les herbicides utilisés sont aussi similaires. La seule fumure organique utilisée est la paille, qui est laissée dans le champ par tous les AB et une partie importante des producteurs.

Toutefois, des différences significatives existent sur les plans du calendrier cultural, de la qualité des aménagements hydro-agricoles et de la flexibilité des approvisionnements. La combinaison de ces différences rend difficile une anticipation des effets à moyen terme sur la fertilité des sols et les rendements.

Premièrement, les petits producteurs ont une intensité culturale plus faible que celle des AB car les actions collectives relatives à l'accès aux intrants, à l'irrigation et à la mécanisation provoquent des retards et entravent l'enchaînement de la contre-saison et de l'hivernage (Tanaka et al., 2015; Diagne et al., 2013; Le Gal and Papy, 1998). Les AB ont une plus grande autonomie, notamment par l'utilisation de groupes motopompes sur des périmètres irrigués privés (77.8%). Deuxièmement, les aménagements hydro-agricoles sont de qualités différentes. 96.6% des parcelles cultivées par des AB sont jugées de mauvaise qualité sur le plan du planage (51.85%) et du drainage (40.74%). Les AB utilisent moins d'intrants de synthèse pour limiter le risque économique. Au contraire, les parcelles des petits producteurs sont localisées sur des périmètres transférés jugés de bonne qualité (96.6%). Troisièmement, les petits producteurs appuyés par la SAED utilisent des quantités un peu plus importantes d'intrants de synthèse que ceux réalisant un contrat de production avec un rizier. La SAED demande aux organisations de producteurs de réaliser une expression de leurs besoins en intrants en début de saison, puis l'itinéraire technique est mis en œuvre avec peu d'ajustements possibles. Les producteurs engagés dans un contrat de production ont plus de flexibilité car ils ont la possibilité d'acheter des intrants auprès du rizier tout au long de la saison.

Tableau 3 : Comparaison des pratiques agricoles

	Recommandations de la SAED	Transaction spot	Contrat de production	Hiérarchie
Nombre d'observations		61	27	30
Rendement (T/ha)		7,64	6,67***	6,94***
Semences (kg/ha)	80-120	128.24	145.15***	142.24***
Réalisation d'un labour (%)	Tous les 3 ans	1.31	0.4***	0***
Nombre de drainages	5	4,96	3,14***	3,5***
Urée kg/ha	250-300	348,8	330,8***	335***
DiAmmonium Phosphate kg/ha	100	99,44	102*	96,6*
Propanyl (litre par hectare)	8	6.22	5.43	4.93**
Weedone (litre par hectare)	1	1.39	0.66***	0.13***
Londax (grammes par hectare)	100	42.6	40.74	46.66
Intensité culturale	200%	115%	122%	195,84%***
Taux de rotation (3 dernières années)		0%	21.87%	0%
Parcelles semées hors période recommandée (%)		39%	22%	13%***
Fumure organique		80.3%	88.8%	100%***

Source : enquête et suivi de 118 parcelles.
Le groupe de comparaison est « Transaction spot ». La significativité des t-tests est indiquée par * p<0,1 ; ** p<0,05 ; *** p<0,01.

F. Discussion

Le croisement des cadres conceptuels de la gouvernance des chaînes de valeur et de la gouvernance territoriale met en évidence que, suite aux investissements d'AB, le changement de participation des petits producteurs dans la gestion des ressources agricoles dépend de la prise en compte des institutions coutumières et légales. De plus, les effets sur les petits producteurs sont différents en fonction des types de producteurs.

Les études de cas montrent que la prise en compte par un AB s'installant sur un territoire des institutions coutumières et des institutions légales influence l'évolution de la gouvernance territoriale. L'entreprise Senhuile-Senethanol n'a pas consulté les petits producteurs et a mis en œuvre un mode de gouvernance territoriale basé sur la communication quant à ses décisions de gestion de certaines ressources agricoles. La non-prise en compte des institutions coutumières de gestion du foncier et de l'eau d'abreuvement a mené à une mobilisation des petits producteurs visant à réintégrer la gouvernance territoriale. Le cas de l'AB West African Farm montre que la négociation d'un AB avec les producteurs familiaux ne suffit pas à la mise en œuvre d'une gouvernance territoriale qui leur est favorable. En effet, ces producteurs, représentés par le conseil rural, ont négocié des aménagements hydro-agricoles mais la règle d'attribution du foncier irrigué entre les producteurs n'a pas été clarifiée, et seule une partie des aménagements a été réalisée. Toutefois,

en dépit d'une gouvernance territoriale qui leur est moins favorable, une partie des producteurs familiaux accepte l'arrivée des AB car ils fournissent certaines infrastructures socio-économiques de base. Pour que les petits producteurs ne voient pas leur contrôle des ressources agricoles territoriales diminuer avec l'arrivée d'un AB, il semble donc nécessaire que l'implantation prenne en compte les règles coutumières de gestions des ressources agricoles, en plus d'identifier des dispositifs légaux de contrôle et d'application des accords établis.

D'autre part, le croisement de la gouvernance des chaînes de valeur et de la gouvernance des territoires met en évidence que les investissements d'AB ont des effets qui diffèrent en fonction du type de producteurs (Figure 3). Les AB s'implantent dans des zones agro-écologiques différentes, ou des producteurs familiaux exercent des activités agricoles différentes, ce qui donne lieu à des liens et à des effets différents.

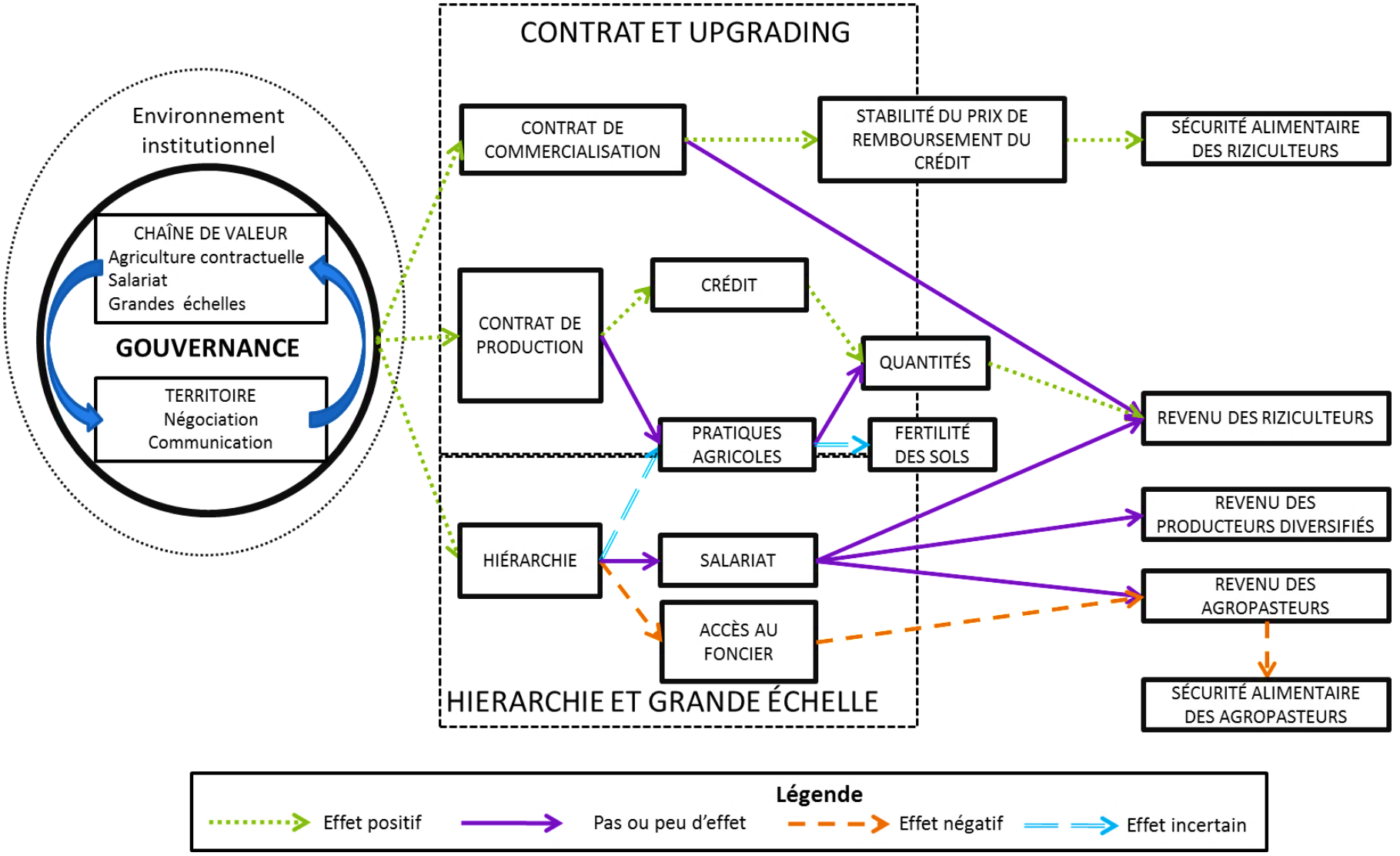
Dans le cas des riziculteurs, localisés dans le Walo, les enquêtes montrent que la tendance vers l'intégration verticale provoque un upgrading. Le contrat de production a un effet positif sur le revenu des petits producteurs exclus du crédit bancaire lorsque ces derniers sont comparés aux producteurs ne cultivant pas par manque de crédit. Le contrat de commercialisation a un effet positif sur la sécurité alimentaire des petits riziculteurs. Il y a aussi un effet de l'intégration verticale sur le revenu des petits producteurs par le biais du salariat (Van den Broeck et al., 2017). Toutefois, cet upgrading est limité. En effet, une partie de la littérature traitant des impacts de la coordination verticale met en évidence que les contrats permettent l'accès à des intrants de synthèse et à des conseils techniques, ce qui provoquent une amélioration des rendements, de la qualité du produit et du revenu (Reardon et al., 2009; Swinnen and Maertens, 2007). Dans la vallée du fleuve Sénégal, les contrats provoquent peu ou pas de modification des pratiques agricoles et des rendements puisque la riziculture a été intensifiée à partir de 1973 (Le Gal, 1995). L'effet positif du contrat de production opère par le biais de l'accès au crédit pour les producteurs exclus de la banque nationale et qui n'ont pas d'autre source de financement. Il génère toutefois un profit par kilogramme inférieur à celui des riziculteurs financés par la banque nationale. En plus, le salariat pour un AB contrôlant hiérarchiquement la riziculture touche peu de ménages. Enfin, les effets de l'intégration verticale sur la fertilité des sols restent incertains puisque l'intensité culturale augmente mais les AB utilisent des quantités légèrement inférieures d'intrants de synthèse.

Pour les producteurs diversifiés, localisés dans le Diéri, les enquêtes montrent qu'il y a peu d'effets de l'intégration verticale. Le contrôle hiérarchique de la production influence positivement le revenu par le biais du salariat, mais peu de ménages sont concernés par une embauche. L'amélioration de l'accès au

foncier ne concerne aussi qu'une petite partie des producteurs. L'AB ne s'approvisionne pas auprès des petits producteurs.

Pour les agropasteurs, localisés dans le Ferlo, les enquêtes montrent que les effets sont surtout négatifs. En effet, l'avancée du front agricole irrigué entre en conflit avec les cultures non-irriguées et le pastoralisme. L'accaparement de foncier non immatriculé concerne un nombre important de producteurs. Les agropasteurs voient aussi leur accès à l'eau d'abreuvement contraint. Ces deux facteurs impactent négativement leur revenu et leur sécurité alimentaire. L'intégration verticale de la production agricole par les AB est toutefois génératrice d'emploi, mais cela concerne peu de ménages.

Figure 3: Chemins d'impacts dans la vallée du fleuve Sénégal



G. Conclusion et recommandations

Suite à la crise des prix de 2007, les Etats ouest africains ont développé des politiques encourageant les investissements d'AB dans la production agricole. L'arrivée de ces acteurs sur des territoires occupés par des agriculteurs familiaux peut avoir des effets sur l'organisation des territoires et la performance des petits producteurs. Nous utilisons le cadre théorique de la gouvernance des chaînes de valeur (Gereffi et al., 2005) et de la gouvernance territoriale (Beuret, 2006) pour comprendre quels sont les effets d'investissements d'AB sur la gestion des ressources agricoles du territoire, ainsi que sur l'accès au foncier, le revenu, la sécurité alimentaire et les pratiques agricoles des petits producteurs. Pour répondre à ces questions, nous avons réalisé des entretiens semi-directifs, deux enquêtes quantitatives et un atelier participatif.

Le territoire étudié est le département de Dagana, situé dans la vallée du fleuve Sénégal, où vivent 45000 petits producteurs. Ces producteurs diffèrent par leurs zones agro-écologiques, leurs activités agricoles, les types de foncier qu'ils utilisent et leurs ethnies. Suite à la crise des prix, les politiques agricoles ont soutenu les investissements de la part d'AB, notamment par des attributions foncières. Des AB ont investi dans la production et parfois la transformation de paddy, de produits maraîchers et d'agrocarburants. Ils mettent en place des stratégies différentes d'insertion territoriale. Une tendance vers l'intégration verticale de la production agricole est observée, avec la mise en place de contrats et de relations salariales avec les exploitants familiaux.

Le croisement des cadres conceptuels de la gouvernance des chaînes de valeur et de la gouvernance territoriale met en évidence que, suite aux investissements d'un AB, l'évolution de la participation des producteurs dans la gestion des ressources agricoles du territoire dépend de la prise en compte des institutions coutumières et de mécanismes légaux de contrôle et d'application des accords. Toutefois, en dépit d'une gouvernance territoriale qui leur est moins favorable, une partie des producteurs familiaux accepte l'arrivée des AB car ils fournissent certaines infrastructures socio-économiques de base. De plus, les effets de la coordination verticale sur les petits producteurs sont différents en fonction des types de producteurs. Les riziculteurs bénéficient de crédits et de contrats stabilisant leur prix de vente, alors que les agropasteurs voient une partie des espaces dédiés au pâturage et aux cultures non-irriguées occupées par des investissements à grande échelle. Des relations salariales sont aussi observées, avec un effet positif sur le revenu, mais elles concernent un nombre limité de petits producteurs. Le contrôle hiérarchique de la production provoque aussi une augmentation de l'intensité culturale dont les effets sont incertains.

Nous formulons trois recommandations aux politiques publiques. Premièrement, les attributions foncières peuvent aboutir à des conflits lorsque l'implantation des AB est peu contrôlée par les pouvoirs

publics, et lorsque la diversité des producteurs du territoire n'est pas prise en compte. L'Etat sénégalais facilite l'insertion territoriale des investisseurs agro-industriels. Néanmoins, il n'existe toujours pas de cadre au marché foncier coutumier, qui continue de se développer dans la vallée. La Commission Nationale de Réforme Foncière mise en place par décret en 2012 a pour mission de mettre en place ce cadre juridique et institutionnel qui assurera plus de transparence et de garanties aux investisseurs privés. La politique foncière en cours de validation va dans ce sens, mais devra insister aussi sur l'importance de sécuriser les transactions au profit des exploitations familiales.

Deuxièmement, les pratiques agricoles dans la vallée du fleuve Sénégal, qui sont soutenues par une politique productiviste, sont intensives en intrants de synthèse. La majorité des petits producteurs ne réalise qu'une seule campagne par an du fait de contraintes d'organisation. Mais les AB ont une intensité culturale plus élevée. Le risque encouru est une baisse de rendements ainsi que des effets négatifs sur l'environnement. Nous recommandons une réflexion sur la mise en œuvre d'une agriculture écologiquement intensive, prenant particulièrement en compte les synergies possibles avec l'élevage.

Troisièmement, les petits riziculteurs financés par contrat de production ont un bénéfice inférieur à celui des producteurs financés par la banque nationale. Nous recommandons l'appui de la recherche au développement d'une assurance du crédit agricole adaptée aux risques rencontrés par les producteurs. Nous recommandons aussi l'intégration de la négociation du prix d'achat des contrats de production au sein de l'interprofession, avec la décomposition du taux d'intérêt et de la prime d'assurance

4. Guides d'entretiens[71] et questionnaires

4.1 Guide d'entretien : producteurs

a) Historique

- Depuis combien de temps êtes-vous agriculteurs
- Comment avez-vous commencé ?

b) Caractéristiques de l'exploitation

- Quel est l'âge du chef d'exploitation ?
- Combien de personnes vivent sur l'exploitation ?
- Combien de travailleurs vivent sur l'exploitation ?
- Quelle surface totale cultivez-vous cette année ?
- Est-ce que le riz est votre première source de revenu ? D'alimentation?
- Etes-vous membre d'une union de producteurs ? Si oui, quels sont ses apports ?

c) Riziculture

a. Organisation :

- Quelle surface de riz cultivez-vous ? Quelle surface est irriguée ?
- Pratiquez-vous la double culture ?
- Quels outils possédez-vous pour cultiver le riz ?
- Avez-vous recours au salariat ? A des travailleurs journaliers ? Si oui, depuis quand ?

b. La qualité :

- Quels mots sont utilisés pour parler de la bonne et mauvaise qualité d'un riz ?
- Quelles sont les caractéristiques d'un riz de bonne qualité ? (impuretés ? Propreté ? Couleur ? Gout ? Gonflement à la cuisson ?)
- Qu'est-ce qu'un riz de mauvaise qualité ?
- Quelles variétés de riz cultivez-vous ? Depuis quand ?
- Quelles qualités de riz produisez-vous ? Depuis quand ? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?

[71] The following interview guides were used to begin discussions with the stakeholders of the rice value chain in Senegal. They led to more detailled questions. Discussions were in french, or in Wolof/Poular with translation in french.

c. Les inputs :

- Recevez-vous des conseils techniques extérieurs (mini-rizerie…) ? Si oui, depuis quand ? Par qui ?
- Comment obtenez-vous vos semences ? Depuis quand ?
- Comment obtenez-vous votre engrais ? Depuis quand ?
- Comment avez-vous accès à la mécanisation ? Depuis quand ?
- Avez-vous accès à une source de crédit ? Si oui laquelle ? Qui est le garant ? Depuis quand ?

d) Commercialisation du riz :

a. La stratégie :

- Vendez-vous votre riz ? Si oui, à qui ?
- Le vendez-vous décortiqué ou en paddy ?
- Si vous le faites décortiquer, comment ?
- Vendez-vous votre riz en une seule ou plusieurs fois ? Pourquoi ?

b. Les accords

- Quels sont les mots pour parler de la relation avec un acheteur (client, asso…) ?
- Comment décrivez-vous vos relations avec vos acheteurs ?
- Vous engagez vous à vendre votre production uniquement à cet acheteur ? A-t-il la priorité par rapport à d'autres acheteurs ?
- Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?
- A quel moment est ce que votre acheteur vous paye ?
- Est-ce que votre acheteur vous fournit certaines ressources ?
- Signez-vous un contrat formel avec vos acheteurs ?
- Depuis quand avez-vous ce type de relation avec votre acheteur? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Est-ce que vos acheteurs vous ont demandé de changer votre activité ? Si oui pourquoi ? Comment ?
- Pour les producteurs commercialisant auprès de mini-rizeries récemment implantées, comment sont organisées vos relations économiques avec ces acteurs ?
- Quelles sont les conditions pour vendre à une mini-rizerie?
- Quels changements implique la vente à des mini-rizeries?
- Voudriez-vous changer d'acheteur ? Pourquoi ? Avec qui voudriez-vous travailler ?

c. La vente

- Quel est le prix de vente en fonction des différentes qualités de riz ?
- Comment connaissez-vous les prix sur les marchés ?
- Ou est-ce que votre acheteur récupère le riz ?

4.2 Guide d'entretien : décortiqueuses villageoises

a) Historique

- Qui possède la décortiqueuse? Depuis quand ?
- Comment l'avez-vous obtenue ? Y a-t-il eu un crédit ?
- Qui vient habituellement faire décortiquer son riz ?

b) Caractéristiques de la décortiqueuse

- Quelles est le modèle de la décortiqueuse ?
- Quel est son rendement ?
- Fonctionne-t-elle toute l'année ?
- Y a-t-il des salariés ou travailleurs journaliers? si oui combien ?
- Quel volume avez-vous transformé l'année dernière ? Pensez-vous que ce sera identique cette année ?
- Ou sont les décortiqueuses concurrentes ?

c) La qualité :

- Quels mots sont utilisés pour parler de la bonne et mauvaise qualité d'un riz ?
- Quelles sont les caractéristiques d'un riz de bonne qualité ? (impuretés ? Propreté ? Couleur ? Gout ? Gonflement à la cuisson ?)
- Qu'est-ce qu'un riz de mauvaise qualité ?
- Quelles qualités de riz décortiquez-vous ? Depuis quand ?
- Ciblez-vous uniquement certaines variétés de riz ? Si oui lesquelles ? Pourquoi ?

d) La prestation de service :

- Je suis riziculteur, j'ai du paddy à décortiquer, quel arrangement me proposez-vous?
- Ou est-ce que le paddy que vous décortiquez est produit ?
- Comment est organisé le transport ?
- Comment est déterminé le prix du décorticage ? Quel est-il ?
- Quelle est votre marge pour une unité décortiquée ?
- Est-ce que les exigences de vos clients ont récemment évoluées ? Si oui comment ?

e) Les riziculteurs

- Quel mot utilisez-vous pour parler de votre relation avec eux (asso, client…) ?
- D'où viennent-ils ?
- De quels groupes ethniques sont-ils ?

- Cultivent-ils plus de 2 ha ?
- Avez-vous des relations avec des unions de producteurs ? Si oui lesquelles ?
- Une fois le décorticage réalisé, le riz est-il majoritairement consommé ou vendu ?
- Ou est-ce que le riz est consommé ?
- Voudriez-vous changer de partenaires ? Pourquoi ? Avec qui voudriez-vous travailler ?

4.3 Guide d'entretien : rizeries

a) Historique

- Quand la rizerie a-t-elle été créée ? Par qui ? Comment ?

b) Activités de la rizerie

a. Organisation :

- Combien de salariés travaillent dans cette rizerie ?
- Quelles machines utilisez-vous pour la transformation du riz ? Depuis quand ?
- Quels sont leurs rendements ?
- Avez-vous accès au crédit ? Si oui comment ?
- Quel volume avez-vous transformé l'année dernière ? Pensez-vous que ce sera identique cette année ?
- Quelles sont les rizeries concurrentes (noms)?

b. La qualité :

- Quels mots sont utilisés pour parler de la bonne et mauvaise qualité d'un riz ?
- Quelles sont les caractéristiques d'un riz de bonne qualité ? (impuretés ? Propreté ? Couleur ? Gout ? Gonflement à la cuisson ?)
- Qu'est-ce qu'un riz de mauvaise qualité ?
- Quelles qualités de riz commercialisez-vous ? Depuis quand ? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Sous quelles formes commercez-vous le produit (vrac, sachet)
- Ciblez-vous uniquement certaines variétés de riz ? Si oui lesquelles ?
- Avez-vous une marque qui permette au consommateur final d'identifier la rizerie? Qui définit la marque?
- Quelle traçabilité pour le consommateur définissez-vous ?

c) Approvisionnement

a. Organisation

- A qui achetez-vous le riz ?
- Ou est-ce que le paddy est produit ?
- Comment est organisé le transport ?
- Comment sélectionnez-vous vos fournisseurs ? Les riziculteurs vous fournissant disposent-ils de plus de 2 ha ?

- Quels changements est ce que les producteurs souhaitant vendre à votre rizerie doivent généralement réaliser ?

b. Les accords

- Quels sont les mots pour parler de la relation avec un fournisseur (client, asso…) ?
- Comment décrivez-vous vos relations avec vos fournisseurs ?
- Est-ce que vous leur donnez des conseils ?
- Etes-vous garant pour qu'ils accèdent au crédit ?
- Leur permettez-vous un accès à des intrants améliorés ? Si oui lesquels ?
- Leur fournissez-vous des services mécanisés ?
- Ces fournisseurs s'engagent t'ils à ne vendre qu'à vous leur riz ? Avez-vous la priorité par rapport à d'autres acheteurs ?
- Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?
- Quel est le prix d'achat en fonction des différentes qualités de riz ?
- A quel moment est ce que vous payez vos fournisseurs ?
- Avez-vous des relations avec des unions de producteurs ? Si oui lesquelles ?
- Est-ce que les riziculteurs vous fournissant cultivent plus de 2 ha ?
- Signez-vous un contrat formel avec vos fournisseurs ?
- Depuis quand avez-vous ce type de relation avec vos fournisseurs ? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Voudriez-vous changer de fournisseur ? Pourquoi ? Avec qui voudriez-vous travailler ?

d) Commercialisation

a. La stratégie :

- Ou est-ce que le riz est consommé ?
- A qui vendez-vous le riz ? A quelle fréquence ?
- Ou est-ce que votre acheteur récupère le riz ?

b. Les accords

- Quels sont les mots pour parler de la relation avec un acheteur (client, asso…) ?
- Comment décrivez-vous vos relations avec vos acheteurs ?
- Vous engagez vous à vendre votre produit uniquement à cet acheteur ? A-t-il la priorité par rapport à d'autres acheteurs ?

- Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?
- Quels prix en fonction du type de produit ?
- Ou est-ce que votre acheteur récupère le riz ?
- A quel moment est ce que votre acheteur vous paye ?
- Signez-vous un contrat formel avec vos acheteurs ?
- Depuis quand avez-vous ce type de relation avec votre acheteur? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Voudriez-vous changer d'acheteur ? Pourquoi ? Avec qui voudriez-vous travailler ?

4.4 Guide d'entretien : grossistes, demi-grossistes et importateurs

a) Historique

- Quand avez-vous débuté votre activité? Comment?
- Quelles sont les récentes évolutions ?
- Y a-t-il beaucoup de concurrents ? Où sont ils localisés ?

b) Activités

a. Organisation :

- En quoi consiste votre activité ?
- Vendez-vous un seul ou plusieurs produits en même temps ?
- Ou est-ce que le riz est produit ? Comment est organisé le transport ? De où à où ?
- Combien de salariés avez-vous ?
- Combien d'entrepôts utilisez-vous?
- De quel autre équipement avez-vous besoin (véhicule…)?
- Quelle part de votre revenu le riz représente-t-il ?

b. La qualité :

- Quels mots sont utilisés pour parler de la bonne et mauvaise qualité d'un riz ?
- Quelles sont les caractéristiques d'un riz de bonne qualité ? (impuretés ? Propreté ? Couleur ? Gout ? Gonflement à la cuisson ?)
- Qu'est-ce qu'un riz de mauvaise qualité ?
- Quelles variétés de riz commercialisez-vous ? Depuis quand ?
- Les produits ont-ils une marque? Si oui, qui définit la marque?
- La traçabilité du riz est-elle possible ? Est-elle importante pour le consommateur ?
- Quelles qualités de riz commercialisez-vous ? Depuis quand ? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Comment êtes-vous informé de la qualité des produits que vous achetez ?

c) Approvisionnement

- A qui achetez-vous le riz ?
- Comment identifiez-vous vos fournisseurs ? Comment les sélectionnez-vous ?
- Quels sont les mots pour parler de la relation avec un fournisseur (client, asso…) ?
- Ces fournisseurs s'engagent t'ils à ne vendre qu'à vous leur riz ? Avez-vous la priorité par rapport à d'autres acheteurs ?

- Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?
- Quel est le prix d'achat en fonction des différentes qualités de riz ?
- A quel moment est ce que vous payez vos fournisseurs ?
- Soutenez-vous vos fournisseurs dans leur activité ? Si oui comment ?
- Avez-vous des relations avec des unions de producteurs ? Si oui lesquelles ?
- Signez-vous un contrat formel avec vos fournisseurs ?
- Depuis quand avez-vous ce type de relation avec vos fournisseurs ? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Voudriez-vous changer de fournisseur ? Pourquoi ? Avec qui voudriez-vous travailler ?

d) Commercialisation

a. La stratégie :

- Ou est-ce que le riz est consommé ?
- A qui vendez-vous le riz ? A quelle fréquence ?
- Le vendez-vous décortiqué ou en paddy ?
- Si vous le faites décortiquer, comment ?
- Ou est-ce que votre acheteur récupère le riz ?

b. Les accords

- Quels sont les mots pour parler de la relation avec un acheteur (client, asso…) ?
- Vous engagez vous à vendre votre produit uniquement à cet acheteur ? A-t-il la priorité par rapport à d'autres acheteurs ?
- Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?
- A quel moment est ce que votre acheteur vous paye ?
- Est-ce que votre acheteur vous fournit certaines ressources ?
- Signez-vous un contrat formel avec vos acheteurs ?
- Depuis quand avez-vous ce type de relation avec votre acheteur? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Est-ce que vos acheteurs vous ont demandé de changer votre activité ? Si oui pourquoi ?
- Voudriez-vous changer d'acheteur ? Pourquoi ? Avec qui voudriez-vous travailler ?

4.5 Guide d'entretien : détaillants

a) Historique

- Quand avez-vous débuté votre activité de vente? Comment?
- Quelles sont les récentes évolutions ?
- Y a-t-il beaucoup de détaillants dans votre ville ?

b) Activités du vendeur

a. Organisation :

- En quoi consiste votre activité ?
- Ou est-ce que le riz est produit ? Comment est organisé le transport ? De où à où ?
- Combien de salariés avez-vous ?
- Combien de magasins utilisez-vous?
- Quelle part de votre revenu le riz représente-t-il ?

b. La qualité :

- Quels mots sont utilisés pour parler de la bonne et mauvaise qualité d'un riz ?
- Quelles sont les caractéristiques d'un riz de bonne qualité ? (impuretés ? Propreté ? Couleur ? Gout ? Gonflement à la cuisson ?)
- Qu'est-ce qu'un riz de mauvaise qualité ?
- Sous quelles formes commercez-vous le produit (paddy, riz…)
- Quelles variétés de riz commercialisez-vous ? Depuis quand ?
- Les produits ont-ils une marque? Si oui, qui définit la marque?
- La traçabilité du riz est-elle possible ?
- Quelles qualités de riz commercialisez-vous ? Depuis quand ? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Comment êtes-vous informé de la qualité des produits que vous achetez ?

c) Approvisionnement

- A qui achetez-vous le riz ?
- Comment identifiez-vous vos fournisseurs ? Comment les sélectionnez-vous ?
- Quels sont les mots pour parler de la relation avec un fournisseur (client, asso…) ?
- Ces fournisseurs s'engagent t'ils à ne vendre qu'à vous leur riz ? Avez-vous la priorité par rapport à d'autres acheteurs ?
- Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?

- Quel est le prix d'achat en fonction des différentes qualités de riz ?
- A quel moment est ce que vous payez vos fournisseurs ?
- Soutenez-vous vos fournisseurs dans leur activité ? Si oui comment ?
- Avez-vous des relations avec des unions de producteurs ? Si oui lesquelles ?
- Signez-vous un contrat formel avec vos fournisseurs ?
- Depuis quand avez-vous ce type de relation avec vos fournisseurs ? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Voudriez-vous changer de fournisseur ? Pourquoi ? Avec qui voudriez-vous travailler ?

d) Commercialisation

a. La stratégie :

- Ou est-ce que le riz est consommé ?
- A qui vendez-vous le riz ? A quelle fréquence ?
- Ou est-ce que votre acheteur récupère le riz ?

b. Les accords

- Quels sont les mots pour parler de la relation avec un acheteur (client, asso…) ?
- Vous engagez vous à vendre votre produit uniquement à cet acheteur ? A-t-il la priorité par rapport à d'autres acheteurs ?
- Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?
- A quel moment est ce que votre acheteur vous paye ?
- Est-ce que votre acheteur vous fournit certaines ressources ?
- Signez-vous un contrat formel avec vos acheteurs ?
- Depuis quand avez-vous ce type de relation avec votre acheteur? Comment est-ce que c'était avant ? Pourquoi avez-vous changé ?
- Est-ce que vos acheteurs vous ont demandé de changer votre activité ? Si oui pourquoi ?
- Voudriez-vous changer d'acheteur ? Pourquoi ? Avec qui voudriez-vous travailler ?

c. Préférences des consommateurs ?

- Est-ce que les goûts de vos acheteurs ont récemment évoluées ? Si oui comment ?
- Est-ce que la marque du riz est importante pour vos clients ?
- Quelle marque préfèrent ils ?
- Est-ce qu'ils veulent savoir d'où vient le riz? Si oui, qu'elle image a le riz de la VFS.

- Est-ce qu'il vous semble que par rapport au riz importé, celui de la VFS se vend de mieux en mieux ou plus difficilement ?

4.6 Guide d'entretien : organisations de recherche et de développement

a) Vue d'ensemble :
   - Quelles sont les zones de la VFS commercialisant le plus de riz ?
   - Quels sont les bassins de consommation ?
   - Qui sont les acteurs de la chaîne de valeur?
   - Quelles sont les organisations d'acteurs (GIE, OP, Organisation des transformateurs, pour le transport…) ?
   - Quelle est la forme dominante de transformation ?
   - Quelles sont les mini rizeries récemment implantées (noms)

b) La qualité :
   - Quels mots sont utilisés pour parler de la bonne et mauvaise qualité d'un riz ?
   - Quelles sont les caractéristiques d'un riz de bonne qualité ? (impuretés ? Propreté ? Couleur ? Gout ? Gonflement à la cuisson ?)
   - Qu'est-ce qu'un riz de mauvaise qualité ?
   - Y a-t-il eu une amélioration de la qualité durant les dernières années ? Pourquoi ?

c) Les producteurs :
   - Qui sont les producteurs impliqués avec une mini-rizerie (petits ou grands)?
   - Ou sont-ils majoritairement localisés ?
   - Quelles caractéristiques (foncier, main d'œuvre…) les distinguent des producteurs vendant aux autres transformateurs (décortiqueuses…).
   - Quelles variétés de riz produisent-ils ?

d) Les mini rizeries :
   - Ou se trouvent les mini rizeries?
   - Quels sont leurs produits (riz entier/brisé, vrac/sachet…)
   - Auprès de qui s'approvisionnent-elles ?
   - A qui vendent-elles ?

e) Les accords :
   - Quels sont les mots pour parler de la relation entre acheteur et vendeur ?
   - Quelles sont les différentes formes d'organisation observées entre producteurs et leurs acheteurs (mini-rizeries modernes, collecteurs…)?
   - Sur quels critères une mini-rizerie sélectionne les producteurs ?
   - Les accords sont-ils exclusifs ? de priorité ?
   - Un prix et une quantité sont-ils décidés avant la vente ? Quels sont les éléments pris en compte dans la négociation ?
   - Les paiements sont-ils à crédit ?
   - Quand y a-t-il fourniture de ressource ?

- Est-ce que les contrats sont formels ou informels ?

f) Performance :

- Les mini-rizeries parviennent elles à écouler leurs produits ?
- Ont-elles des stratégies de marque?
- La traçabilité est-elle importante pour le consommateur ?
- Les producteurs préfèrent ils travailler avec une mini-rizerie ou d'autres transformateurs?
- Qui selon vous a la marge la plus importante dans la chaîne de valeur.
- Les producteurs sont mieux rémunérés en vendant à quels acteurs ?

g) Identification d'acteurs pour les entretiens (voir liste entretiens ou autres)

4.7 Questionnaire aupres des riziculteurs

1. Suivi du questionnaire

(1) Numéro de questionnaire:
(2) Nom de l'enquêteur:
(3) Date de l'enquête :
(4) Relecture par l'enquêteur : □ Oui □ Non
(5) Relecture par le coordinateur : □ Oui □ Non
(6) Contrôle téléphonique du questionnaire fait par (nom) :
(7) Saisie 1 faite par :
(8) Saisie 2 faite par :
(9) Numéro de téléphone du répondant (ou d'un proche) :

2. Organisation de la riziculture

(10) Nom de l'OP d'échantillonnage :
(11) Nom du répondant :
(12) Est-ce que le chef de production est le chef d'exploitation (= de ménage)? □ Oui □ Non
(13) Depuis quand est-il chef de production ?……
(14) En 2014, est-ce qu'au moins un membre du ménage a travaillé pour un rizier? □ Oui □Non
(15) Si oui, combien ?.....
(16) Surface totale possédée par le chef de production:
(17) Surface aménagée possédée par le chef de production :
(18) En 2014, surface cultivée en riz en <u>contre saison</u> par le chef de production:
(19) En 2014, surface cultivée en riz en <u>hivernage</u> par le chef de production
(20) De quels types d'OP êtes-vous membres ?

- □ GIE
- □ Union Hydraulique
- □ Section Villageoise
- □ Association de producteurs (FPA, Feprodès, Pinord…) : Préciser :……
- □ Autre (préciser) :……
- □ Aucune

(21) Est-ce que l'unité de production a vendu du paddy ou riz en 2014? □ Oui □ Non
(22) Types de ventes

Num	Produit vendu	A-t-il vendu pour rembourser la banque ?	Acheteur	Accord	Est-ce que le type de vente a été réalisé ?	Si oui, numéroter	
						Contre saison	Hivernage
1	Riz	Non	Banabana	Négociation	□ Oui □ Non	(23)	(24)
2	Paddy	Non	Rizerie	Contrat de production	□ Oui □ Non	(25)	(26)
3	Paddy	Oui	Banabana	Négociation	□ Oui □ Non	(27)	(28)
4	Paddy	Oui	Rizerie	Contrat de commercialisation	□ Oui □ Non	(29)	(30)
5	Paddy	Oui	Rizerie	Négociation	□ Oui □ Non	(31)	(32)
6	Paddy	Non	Banabana	Négociation	□ Oui □ Non	(33)	(34)
7	Paddy	Non	Rizerie	Négociation	□ Oui □ Non	(35)	(36)
8	Paddy	Non	Rizerie	Contrat de commercialisation	□ Oui □ Non	(37)	(38)

3. Facteurs de production

	QUESTIONS	Contre Saison	Hivernage
Foncier	(39) Surface cultivée en riz		
	(40) Modes de faire-valoir *Direct = 1 ; Fermage = 2 ; Métayage =3*		
	(41) Si location, quel est le prix par saison (FCFA ou sacs)		
	(42) Nombre de parcelles		
Préparation de l'irrigation	(43) Fréquence d'utilisation d'un grader en années (entre les 2 dernières utilisations ou la dernières et la prochaine)		
	(44) Est-ce que la dernière utilisation d'un grader a été faite dans le cadre d'un contrat de production ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(45) Qui a payé ? *Le producteur = 1 ; La SAED = 2 ; Autre (préciser) = 3*		
	(46) Nombre d'heures d'utilisation par le producteur lors de la dernière utilisation		
	(47) Coût de la main d'œuvre pour la réfection des diguettes		
	(48) Nombre de jour-hommes de travail non rémunéré pour la réfection des diguettes (famille, entraide…)		
	(49) Réalisation d'un planage ? *Pas de planage = 1 ; Manuel = 2 ; Mécanique = 3 ; Autre (spécifier) = 4*		
	(50) Est-ce que le planage a été fait dans le cadre d'un contrat de production ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(51) Prix pour la surface totale?		
Façon culturale	(52) Réalisation d'un offsetage ? *Pas d'offsetage = 1 ; Manuel = 2 ; Mécanique = 3 ; Autre (préciser)= 4*		
	(53) Est-ce que l'offsetage a été fait dans le cadre d'un contrat de production ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(54) Prix pour la surface totale?		
Semences	(55) Avez-vous utilisé des semences certifiées ?	☐ Oui ☐ Non ☐ Mélange	☐ Oui ☐ Non ☐ Mélange
	(56) Quelle est la variété des semences utilisées (celle dominante)?		
	(57) Date de début du semis	…./…./….	…./…./….
	(58) Vendeurs des semences ? *Commerçant = 1 ; Autoproduction = 2 ; Producteur non-certifié = 3 ; producteur semencier certifié = 4 ; Industriel (contrat de production) = 5 ; Centre de tri = 6 ; Autre (préciser) = 7*		
	(59) Nombre de sacs de semences?		
	(60) Poids d'un sac ?		
	(61) Prix d'un sac ?		
	(62) Coût total du transport de la semence du lieu d'achat à la parcelle?		
Désherbage	(63) Comment désherbez-vous? *Pas de désherbage = 1 ; Manuel =2 ; Chimique = 3 ; Autre (préciser) = 4*		
	(64) Si chimique, qui vend le produit ? *Commerçant = 1 ; Transformateur (Contrat de production) = 2 ; Autre*		

	(préciser) = 3		
	(65) Prix pour l'ensemble des produits chimiques (propanil, weedone, londax, samory, round-up…)		
	(66) Coût de transport (lieu d'achat-parcelle) pour l'ensemble des désherbants (véhicule + manutention)		
	(67) Coût de location des pulvérisateurs		
Fertilisation organo-minérale	(68) Utilisation de <u>fumure organique</u> ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(69) Prix payé pour la fumure		
	(70) Quantité de <u>18-46</u> utilisée (Nombre de sacs et poids d'un sac)		
	(71) Prix payé par le producteur pour un sac de 18-46		
	(72) Subvention du 18-46 ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(73) Vendeur? *Commerçant = 1 ; Industriel (contrat de production) = 2 ; Autre (préciser) = 3*		
	(74) Quantité d'<u>urée</u> utilisée (Nombre de sacs et poids d'un sac)		
	(75) Prix payé par le producteur pour un sac d'urée		
	(76) Subvention de l'urée ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(77) Vendeur? *Commerçant = 1 ; Industriel (contrat de production) = 2 ; Autre (préciser) = 3*		
	(78) <u>Autre engrais</u> (préciser)		
	(79) Quantité utilisée (Nombre de sacs et poids d'un sac)		
	(80) Prix payé par le producteur pour un sac		
	(81) Subvention ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(82) Vendeur? *Commerçant = 1 ; Industriel (contrat de production) = 2 ; Autre (préciser) = 3*		
	(83) Coût de transport de l'ensemble des engrais du lieu d'achat à la parcelle (véhicule + manutention)		
Mise en eau	(84) Comment avez-vous réalisé la mise en eau ? *Motopompe privée= 1 ; Système collectif = 2 ; Autre (préciser) = 3*		
	(85) Quel est le coût total pour l'irrigation (redevance, OMVS, FOMAED, gasoil, location GMP, transport GMP…)		
	(86) Si l'irrigation est gratuite, pour quelle surface ?		
Main d'œuvre saisonnière	(87) Combien de travailleurs saisonniers avez-vous embauché?		
	(88) Combien de mois ?		
	(89) Quel est leur salaire mensuel ?		
	(90) Etaient-ils nourris et logés ?	☐ Oui ☐ Non	☐ Oui ☐ Non
Récolte et mise en meule	(91) Dates de la récolte	Du…./…./…. Au…./…./….	Du…./…./…. Au…./…./….
	(92) Quel est le mode de récolte ? *Manuel = 1 ; Mécanisé = 2 ; Autre (préciser)= 3*		
	(93) Si récolte mécanisée, était ce dans le cadre d'un contrat de production ?	☐ Oui ☐ Non	☐ Oui ☐ Non

	(94) Si moissonneuse-batteuse, prix (FCFA ou nombre de sacs et poids d'un sac) ?		
	(95) Coût total du travail journalier (dont les femmes) pour la récolte et la mise en meule (si en paddy, préciser les kg)		
	(96) Nombre de jour-homme de travail non rémunéré (entraide, famille…) pour la récolte et la mise en meule		
	(97) Est-ce que le riz a versé ou s'est égrainé?	☐ Oui ☐ Non	☐ Oui ☐ Non
Battage et ensachage	(98) Quel est le mode de battage ? *Manuel = 1 ; Batteuse (ASI …) = 2 ; Moissonneuse-batteuse = 3 ; Autre (préciser) = 4*		
	(99) Si batteuse, possédez-vous la batteuse ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(100) Si batteuse, était ce dans le cadre d'un contrat de production ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(101) Quel est le prix pour l'utilisation de la batteuse (FCFA ou proportion de la récolte) ?		
	(102) Nombre de jours-homme de travail non rémunéré (famille, entraide…) pour le battage et l'ensachage		
	(103) Coût total de la manutention pour le battage et l'ensachage (si en paddy, préciser le nombre de kg)		
	(104) Combien de sacs de paddy de 80kg avez-vous récolté sur l'ensemble des parcelles (avant tout paiement ou don)?		
Transport	(105) Comment est réalisé le transport du paddy? *Transport géré par le transformateur = 1 ; Charette =2 ; Camionnette ou camion = 3 ; Autre (précisez) = 4*		
	(106) Pour combien de sacs avez-vous pris en charge le transport (retirer les paiements en nature)		
	(107) Combien a coûté le transport au total pour ces sacs (si en paddy, préciser le nombre de kg)		
Stockage	(108) Ou stockez-vous votre paddy (plusieurs réponses possibles)? *A l'extérieur = 1 ; Dans une pièce de la maison = 2 ; Dans un magasin que vous possédez = 3 ; Dans un entrepôt collectif = 4 ; Autre (préciser) = 5*		
	(109) Nombre de sacs dans un entrepôt collectif		
	(110) Coût total pour la manutention et le stockage (si en paddy, préciser kg)		
Assurance	(111) Avez-vous souscrit à une assurance pour la saison ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(112) Si oui, coût pour la saison		
	(113) Avez-vous été indemnisé suite à une catastrophe ?	☐ Oui ☐ Non	☐ Oui ☐ Non
	(114) Si oui, quel est le montant du remboursement (FCFA)?		

4. Utilisations du paddy

Utilisations	Contre saison	Hivernage
(115) Nombre de sacs récoltés		
(116) Dons (Assaka + autres)		
(117) Nombre de sacs pour paiement des charges d'exploitation et remboursement des crédits.		
(118) Nombre de sacs de paddy et de riz vendus hors paiements et hors remboursements des crédits		
(119) Avez-vous produit assez de paddy pour la consommation de la famille	Jusqu'à la récolte d'hivernage : □ Oui □ Non	Jusqu'à la date de l'enquête : □ Oui □ Non
(120) Si oui, quel est le nombre de sacs de paddy dans le grenier	A la récolte d'hivernage :	A la date de l'enquête :
(121) Si non, à quelle date est ce que le grenier a été épuisé ?		
(122) Si non, quelle(s) céréale(s) avez-vous acheté pour combler le déficit ?		
(123) Achat de ces céréales à crédit ?	□ Oui □ Non	□ Oui □ Non
(124) Nombre moyen de sacs consommés par mois		
(125) Question pour l'enquêteur : est-ce que le total des sacs utilisés est égal au total des sacs récoltés ?	□ Oui □ Non	□ Oui □ Non

5. Le financement

Modes de financement	Contre saison	Hivernage
(126) Location foncier		
(127) Préparation de l'irrigation (grader, planage…)		
(128) Offset		
(129) Semences		
(130) Main d'œuvre pour le semi		
(131) Désherbants		
(132) Engrais		
(133) Coût hydraulique		
(134) Travailleurs saisonniers		
(135) Récolte et mise en meule		
(136) Battage et ensachage		
(137) Stockage		

Modes de financement : Pas de paiement = 1 ; Autofinancement = 2 ; Crédit CNCAS = 3 ; Crédit autre banque (préciser)= 4 ; Contrat de production = 5 ; Crédit auprès d'un banabana = 6 ; Subvention = 7 ; Autre (préciser) = 8

Saison	Les crédits	Est-ce que le producteur a remboursé le crédit ?	Mode de remboursement du producteur	Exigible (incluant intérêts)	Durée du crédit (mois)	Taux d'intérêt pour la durée (si banque)	Nombre de sacs	Prix d'un sac payé par l'acheteur pour le remboursement
Contre saison	(138) CNCAS	□ Oui □ Non	□Paddy □Argent □ Autre					
	(139) Autre banque	□ Oui □ Non	□Paddy □Argent □ Autre					
	(140) Contrat de production	□ Oui □ Non	□Paddy □Argent □ Autre					
	(141) Banabana	□ Oui □ Non	□Paddy □Argent □ Autre					
	(142) Autre (préciser)	□ Oui □ Non	□Paddy □Argent □ Autre					
Hivernage	(143) CNCAS	□ Oui □ Non	□Paddy □Argent □ Autre					
	(144) Autre banque	□ Oui □ Non	□Paddy □Argent □ Autre					
	(145) Contrat de production	□ Oui □ Non	□Paddy □Argent □ Autre					
	(146) Banabana	□ Oui □ Non	□Paddy □Argent □ Autre					
	(147) Autre (préciser)	□ Oui □ Non	□Paddy □Argent □ Autre					

6. Transformation

Transformation	Questions	Contre saison	Hivernage
Organisation de la transformation	Avez-vous décortiqué du paddy avant de le consommer ou de le vendre ?	□ Oui □ Non	□ Oui □ Non
	Quel type d'unité de transformation est utilisé ? *Décortiqueuse villageoise = 1 ; Mini rizerie = 2 ; Rizerie = 3 ; Autre (préciser) = 4*		
	Qui possède l'unité de transformation? *Le producteur = 1 ; L'OP = 2 ; Association de producteurs = 3 ; Un banabana = 4 ; Une entreprise industrielle = 5 ; Autre (préciser) = 6*		
	Si rizerie ou mini-rizerie, nom de l'entité la possédant		
	Quantité de paddy transformée (sacs 80kg)		
	Quantité de son obtenue (nombre de sacs et poids d'un sac)		
Les charges de la transformation	Prix du transport aller d'un sac de paddy		
	Prix du décorticage d'un sac (prestation de service uniquement)		
	Prix d'un sac de riz (sacherie)		
	Prix du transport retour (retour du sac du riz au lieu de vie)		
La vente de son	Vente 1 : Nombre de sacs vendus		
	Vente 1 : Prix de vente d'un sac		
	Vente 1 : Coût de transport d'un sac		
	Vente 2 : Nombre de sacs vendus		
	Vente 2 : Prix de vente d'un sac		
	Vente 2 : Coût de transport d'un sac		
La vente de paille	Coûts lié à la vente de paille		
	Revenu 1 de la vente de paille		
	Revenu 2 de la vente de paille		

7. La vente

Ventes	QUESTIONS	VENTES			
La transaction	(20) Numéro de transaction (voir première page)				
	(21) Saison :	□ CS ; □ Hiv	□ CS ; □ Hiv	□ CS ; □ Hiv	□ CS ; □ Hiv
	(22) Produit	□ Paddy ; □ Riz	□ Paddy ; □ Riz	□ Paddy ; □ Riz	□ Paddy ; □ Riz
	(23) Vente pour rembourser le crédit bancaire ?	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non
L'acheteur	(24) Qui est l'acheteur ? *Banabana = 1 ; Rizerie = 2 ; Autre (précisez)= 3*				
	(25) Nom de l'acheteur si rizerie				
Le contrat	(26) Accord : *Négociation = 1 ; Contrat de commercialisation = 2 ; Contrat de production = 3 ; Autre (préciser) = 4*				
	(27) Est-ce que le producteur a lu un contrat de vente ?	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non
	(28) Si oui, quelles informations le contrat traitait ? *Le prix = 1 ; La quantité = 2 ; La qualité = 3 ; La fourniture d'intrants = 4 ; L'itinéraire technique = 5 ; Le délai du paiement = 6 ; Autre (préciser) = 7*				
	(29) Si contrat, est ce que certaines conditions n'ont pas été respectées ?	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas
	(30) Si oui, lesquelles ? *Le prix = 1 ; La quantité = 2 ; La qualité = 3 ; La fourniture d'intrants = 4 ; L'itinéraire technique = 5 ; Le délai du paiement = 6 ; Autre (préciser) = 7*				
	(31) Avez-vous rencontré des difficultés pour l'obtention du paiement ?	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non
La qualité	(32) Utilisation d'un humidimètre ?	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas
	(33) Vérification du taux d'impureté par l'acheteur?	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas
Prix et quantités	(34) Si vente en une seule fois, prix de vente par sac				
	(35) Si vente en une seule fois, date de la vente				
	(36) Si vente en une seule fois, nombre total de sacs vendus				
	(37) Si plusieurs ventes à des banabanas, nombre de sacs vendus au moment de la récolte.				

	(38) Prix de vente à la période de récolte				
	(39) Si plusieurs ventes à des banabanas, nombre de sacs vendus durant les deux mois après la récolte.				
	(40) Prix de vente durant les deux mois après la récolte				
	(41) Si plusieurs ventes à des banabanas, nombre de sacs vendus plus de deux mois après la récolte.				
	(42) Prix de vente plus de deux mois après la récolte.				
	(43) A quel moment avez-vous été payé ? *Avant la vente =1 ; Achat au comptant = 2 ; Environ 10 jours après la vente = 3 ; Plusieurs semaines après la vente = 4 ; remboursement d'un contrat de production = 5 ; L'acheteur n'a pas payé = 6 ; Autre (préciser) = 7*				
OP	(44) Est-ce que c'était une vente par le biais d'une OP ?	☐ Oui ☐ Non	☐ Oui ☐ Non	☐ Oui ☐ Non	☐ Oui ☐ Non
	(45) Si oui, quel est le nom de l'OP ?				
	(46) Type d'OP : GIE = 1 ; *Union Hydraulique = 2 ; Section Villageoise = 3 ; Association de producteurs = 4 ; Autre (préciser) = 5.*				
	(47) Année d'adhésion à l'OP				
	(48) Quel est votre lien au président ? *Le répondant est le président = 1 ; Famille = 2 ; Ami = 3 ; Connaissance = 4*				
	(49) Où habitez-vous par rapport au président ? *Même ville/village, proche = 1 ; Même ville/village, éloigné = 2 ; Ville/Village différent =3*				
	(50) A combien de réunions de l'OP participez-vous par an ?				
	(51) Est-ce qu'il y avait différentes variétés dans le lot acheté ?	☐ Oui ☐ Non ☐ Ne sait pas	☐ Oui ☐ Non ☐ Ne sait pas	☐ Oui ☐ Non ☐ Ne sait pas	☐ Oui ☐ Non ☐ Ne sait pas
Localisation	(52) Où est-ce que l'acheteur a récupéré le produit ? *Au lieu de stockage = 1 ; Sur la parcelle ou il a été récolté = 2 ; Sur le marché local = 3 ; A ses locaux = 4 ; Autre (préciser) = 5*				
	(53) Combien avez-vous payé pour amener le paddy à l'acheteur (total ou par sac)?				

8. La riziculture depuis 10 ans

(54) Quelles ont été les principales sources de financement utilisées durant les 10 dernières années? □ Autofinancement ; □ Crédit CNCAS ; □Crédit autre banque ; □ Contrat de production ; □ Crédit auprès d'un banabana ; □ Subvention ; □ Autre (préciser) :……

(55) Vous est-il arrivé de ne pas pouvoir cultiver du riz une année car vous n'aviez pas de crédit pour le financement ? □ Oui □ Non

(56) Depuis que vous faite de la riziculture, est ce que votre récolte vous permet de nourrir votre ménage toute l'année ? □ Jamais ; □ Parfois ; □Souvent ; □ Tout le temps

(57) Question pour les producteurs vendant par contrat : depuis que vous vendez par contrat, est ce que vous parvenez à mieux nourrir votre ménage ? □ Non ; □ Parfois ; □ Souvent ; □ Tout le temps

9. Les caractéristiques du ménage

(58) Les actifs du ménage en 2014:

Lien au répondant (enfant/femme…)	Sexe	Age	Niveau d'éducation scolaire *(Primaire/Secondaire/ Supérieur/Arabe/Coranique)*	Activité principale *Riziculture = 1 ; Maraîchage = 2 ; commerce et artisanat = 3 ; Salariat = 4 ; Autre (précisez) = 5*
Répondant				

(59) Nombre d'inactifs[72] dans le ménage en 2014:…….

(60) Communauté rurale ou commune de l'exploitation:…….

(61) Nom du village ou du quartier :…….

(62) Distance par rapport à la route/piste?.....km

(63) Est-ce que la route/piste existait en 2005 ? □ Oui □ Non

(64) Voie praticable pendant la saison des pluies ? □ Facilement ; □ Difficilement ; □ Non

(65) Pouvez-vous téléphoner depuis votre lieu de vie? □ Oui □ Non

(66) Transports en commun à proximité du village/ de la ville ? □ Oui □ Non

(67) Si oui, quelle est la fréquence ?

□ Moins de 10 véhicules par jour

□ 10 véhicules par jour ou plus

(68) Ethnie du chef du ménage: □ Wolof ; □ Peul ; □ Maure ; Autre (préciser) :

(69) Si village, votre maison par rapport à celle du chef de village est ? □ Proche □ Eloignée

(70) Aviez-vous accès à un entrepôt de stockage en 2010

10. Les revenus du ménage

(71) En 2014, est ce que vous ou d'autres membres avaient d'autres activités agricoles que la riziculture ? □ Oui □ Non

(72) Si oui, lesquelles : □ Maraîchage ; □ Elevage ; □ Pêche ; □ Autre (précisez) :……

(73) En 2014, quelle part est ce que les revenus du paddy et du riz représente dans les revenus de l'agriculture du ménage?.....%

(74) En 2014, est ce que vous ou d'autres membres du ménage avaient des sources de revenu non agricoles ? □ Oui □ Non

(75) Si oui, lesquelles ? □ Commerce et artisanat ; □ Travail salarié ; □ Revenus de la solidarité (dons, emigration…) ; □ Autre (précisez) :

(76) Quelle part est ce que les revenus de l'agriculture représentent dans le revenu total du ménage?.....%

(77) Matériel construction des murs de la maison : □ aucun ; □ brique en ciment ; □ paille ; □ Banco ; Autres (préciser) :

(78) Aviez-vous en 2014 une dette que vous ne parveniez pas à rembourser auprès d'une banque ? □ Oui □ Non

[72] Enfants de moins de 15 ans et adultes ne pouvant pas travailler

11. Le salariat pour un rizier

(79) Est-ce que des membres du ménage travaillent pour un ou plusieurs riziers (champs, usine, administration…) ? □ Oui □ Non

	Nom de l'entreprise	Type de travail Modalités A	Type d'accord Modalités B	Nombre de jours travaillés dans la saison	Salaire pour la saison ou équivalent	Le travailleur est-il logé par l'employeur?	Le travailleur est-il nourri par l'employeur?
Contre Saison						□ Oui □ Non	□ Oui □ Non
						□ Oui □ Non	□ Oui □ Non
Hivernage						□ Oui □ Non	□ Oui □ Non
						□ Oui □ Non	□ Oui □ Non

Modalités A : Type de travail : Culture de riz= 1 ; transformation de paddy= 2 ; Administratif = 3 ; Autre = 4 (préciser);
Modalités B : Types d'accord : Journalier = 1 ; Saisonnier = 2 ; Permanent = 3 ; Autre (précisez) = 4

(80) Pourquoi est-ce que ces travailleurs ne se concentrent pas uniquement sur les travaux rizicoles de leur exploitation? ……

12. L'équipement du ménage

Equipement agricole et non agricole	Nombre	Année de mise en service
Tracteur		
Groupe motopompe		
Batteuse		
Décortiqueuse de paddy		
Charrette		
Gros ruminants (Bovins, équins, asins…)		
Petits ruminants (Caprins, ovins…)		
Magasin de stockage		
Autre équipement agricole (préciser) :		
Voiture		
Moto		
Autre équipement non-agricole (préciser) :		

13. La sécurité alimentaire

N°	Question	Options de réponse
1.	Le mois dernier, étiez-vous préoccupé que votre ménage n'ait pas assez de nourriture (le ménage est l'ensemble des personnes que le chef d'exploitation a la responsabilité de nourrir et de loger).	0 = Non (passer à Q2) 1 = Oui
1.a	Avec quelle fréquence cette situation est-elle survenue ?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
2.	Le mois dernier, est-ce que vous-même ou un membre de votre ménage n'a pas pu manger les types de nourriture que vous préférez (par exemple de la viande, des fruits, des légumes, ou des céréales) à cause d'un manque de ressources (Dans cette situation, la nourriture n'est pas disponible au niveau du ménage et il n'est pas possible d'en acheter car il n'y a pas assez d'argent)?	0 = Non (passer à Q3) 1= Oui
2.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
3.	Le mois dernier, est-ce que vous-même ou un membre de votre ménage a mangé pendant une longue période les mêmes plats alors qu'il aurait préféré manger des plats différents, cela parce que les ressources n'étaient pas suffisantes?	0 = Non (passer à Q4) 1 = Oui
3.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
4.	Le mois dernier, est-ce que vous-même ou un membre de votre ménage a mangé une nourriture que vous ne souhaitiez pas manger à cause du manque de ressources? Exemple : du riz sans sauce.	0 = Non (passer à Q5) 1 = Oui
4.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
5.	Le mois dernier, est-ce que vous-même ou un membre de votre ménage a mangé moins de nourriture que souhaité parce qu'il n'y avait pas assez à manger?	0 = Non (passer à Q6, si réponses « Non » aux trois dernières questions, ne pas faire les questions 6, 7, 8 et 9) 1 = Oui
5.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
6.	Le mois dernier, est-ce que vous-même ou un membre de votre ménage a réduit le nombre de ses	0 = Non (passer à Q7)

	repas par jour parce qu'il n'y avait pas assez de nourriture?	1 = Oui
6.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
7.	Le mois dernier, est-il arrivé que le ménage soit sans nourriture du tout parce qu'il n'y avait pas de ressources pour en acheter?	0 = Non (passer à Q8) 1 = Oui
7.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
8.	Le mois dernier, est-ce que vous-même ou un membre de votre ménage est allé au lit en ayant faim parce qu'il n'y avait pas assez de nourriture?	0 = Non (passer à Q9) 1 = Oui
8.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)
9.	Le mois dernier, est-ce que vous-même ou un membre de votre ménage a passé toute une journée sans manger parce qu'il n'y avait pas assez de nourriture?	0 = Non (passer à la partie suivante) 1 = Oui
9.a	Avec quelle fréquence cette situation est-elle survenue?	1 = Rarement (une ou deux fois le mois dernier) 2 = Parfois (trois à 10 fois le mois dernier) 3 = Souvent (plus de 10 fois le mois dernier)

14. Perspectives

(99) Comment voyez-vous votre activité dans 5 ans ? □ Expansion ; □ Même niveau d'activité ; □ Réduction ; □ Instable ; □ Ne sait pas

(100) Pourquoi ?.....

(101) Que pensez-vous de notre travail ?.....

(102) Question pour l'enquêteur : quelle est la qualité générale des données ? □ Fiables ; □ Incomplètes ; □ Non Fiables ;

(103) Si non fiables ou incomplètes, pourquoi ?.....

(104) Question pour l'opérateur de saisie : quelle est la qualité générale des données ? □ Fiables ; □ Incomplètes ; □ Non Fiables ;

(105) Si non fiables ou incomplètes, pourquoi ?.....

(106) Avez-vous besoin d'un conseil agricole? □ Oui □ Non

4.8 Questionnaire auprès des organisations de producteurs (1/2)

1. L'OP et la riziculture

(1) Numéro de questionnaire :
(2) Nom de l'enquêteur :
(3) Nom de l'OP :
(4) Statut de l'OP: □ GIE ; □ Union Hydraulique ; □ Section Villageoise ; □ Autre (préciser) :
(5) Année de création de l'OP:
(6) Nom du président de l'OP:
(7) Nombre de membres en 2014:
(8) Nombre de membres ayant cultivé du riz en contre saison 2014 :
(9) Nombre de membres ayant cultivé du riz en hivernage 2014 :
(10) Nombre de villages/quartiers concernés par l'OP :
(11) Nombre de réunions de l'OP par an:
(12) Est-ce que l'OP est membre d'une association de producteurs (Feprodès, Pinord, FPA…)? □ Oui □ Non
(13) Si oui, laquelle ou lesquelles :
(14) Pour la riziculture, l'OP a permis à ses membres d'obtenir quels types d'intrants en 2014: □Foncier ; □ Grader ; □ Offset ; □ Semences ; □ Désherbants ; □ Engrais ; □ Mise en eau ; □Moissonneuse-batteuse ; □ Batteuse ; □ Véhicule pour transport ; □ Stockage ; □ Autre (préciser)

2. La commercialisation

(15) Est-ce que l'OP a vendu du paddy ou riz en 2014? □ Oui □ Non
(16) Types de ventes

Produit	Remboursement banque ?	Acheteur	Accord	Vente ?	Si oui, numéroter	
					Contre saison	Hivernage
Riz	Non	Banabana	Négociation	□ Oui □ Non		
Paddy	Non	Rizerie	Contrat de production	□ Oui □ Non		
Paddy	Oui	Banabana	Négociation	□ Oui □ Non		
Paddy	Oui	Rizerie	Contrat de commercialisation	□ Oui □ Non		
Paddy	Oui	Rizerie	Négociation	□ Oui □ Non		
Paddy	Non	Banabana	Négociation	□ Oui □ Non		
Paddy	Non	Rizerie	Négociation	□ Oui □ Non		
Paddy	Non	Rizerie	Contrat de commercialisation	□ Oui □ Non		

(17) Il existe différents mode de ventes à un transformateur (Négociation avec un banabana, contrat de commercialisation, contrat de production, vente de riz après transformation par l'OP…). Lequel ou lesquelles sont les mieux pour l'OP et pourquoi?……

QUESTIONS		VENTES			
(1)	Numéro de transaction (voir première page)				
(2)	Nom de l'acheteur si rizerie				
(3)	Est-ce que l'OP traitait directement avec l'acheteur ou par le biais d'une autre OP ?	□ Direct ; □ Autre	□ Direct ; □ Autre	□ Direct ; □ Autre	□ Direct ; □ Autre
(4)	Si autre, préciser le type et le nom				
(5)	Type d'accord avec l'acheteur: *Négociation = 1 ; Contrat de commercialisation = 2 ; Contrat de production = 3 ; Autre (préciser) = 4*				
(6)	Est-ce qu'un contrat a été écrit ?	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non
(7)	Si oui, quelles informations le contrat comportait ? *Le prix = 1 ; La quantité = 2 ; La qualité = 3 ; La fourniture d'intrants = 4 ; L'itinéraire technique = 5 ; Le calendrier du paiement = 6 ; Autre (préciser) = 7*				
(8)	Est-ce que certaines conditions du contrat n'ont pas été respectées ?	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non	□ Oui □ Non
(9)	Si oui, lesquelles ? *Le prix = 1 ; La quantité = 2 ; La qualité = 3 ; La fourniture d'intrants = 4 ; L'itinéraire technique = 5 ; Le calendrier du paiement = 6 ; Autre (préciser) = 7*				
(10)	Vérification du taux d'humidité par l'acheteur (utilisation d'un humidimètre) ?	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas
(11)	Si oui, était ce en présence de membres de l'OP ?	Oui □ Non	Oui □ Non	Oui □ Non	Oui □ Non
(12)	Vérification du taux d'impureté par l'acheteur?	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas	□ Oui □ Non □ Ne sait pas
(13)	Si oui, était ce en présence de membres de l'OP ?	Oui □ Non	Oui □ Non	Oui □ Non	Oui □ Non
(14)	Des sanctions sur le prix ont-elles été appliquées suite à la mesure des taux d'humidité et/ou d'impureté ?	Oui □ Non	Oui □ Non	Oui □ Non	Oui □ Non
(15)	Quelles étaient les variétés dans le lot de la vente ?				
(16)	Prix de vente d'un sac				
(17)	Nombre de sacs				
(18)	Date de la vente				
(19)	Nombre de producteurs impliqués dans la vente				
(20)	Qui gère le stockage du produit de cette vente? *Chaque producteur = 1 ; L'OP enquêtée = 2 ; L'Union = 3 ; Un entrepôt privé = 4 ; Autre (précisez) = 5*				
(21)	Combien a été prélevé pour le stockage (manutention et gardiennage)?				

4.9 Questionnaire pour les presidents d'organisation de producteurs (2/2)

L'objectif est de comprendre quelles sont les raisons qui incitent les producteurs à réaliser une vente à un banabana (négociation), par contrat de commercialisation ou contrat de production. Nous nous intéressons aux ventes qui ont été réalisées par l'OP, c'est-à-dire les ventes collectives. La vente par négociation a lieu avec un banabana. Le contrat de commercialisation est souvent réalisé avec une rizerie industrielle pour rembourser le crédit de la CNCAS. Le contrat de production a lieu lorsque le rizier industriel fournit les semences, engrais et autre intrants à l'OP et se fait rembourser en paddy. Les producteurs regroupés en OP réalisent souvent des ventes pour rembourser le crédit, et parfois des ventes (individuelles) en plus du remboursement du crédit.

(1) Nom de l'OP : Nom du répondant : Num de tel :

(2) Quels types de ventes est ce que l'OP a réalisée au cours des dernières années ?

	Hivernage 2016	Contre Saison 2016	Hivernage 2015	Contre saison 2015	Hivernage 2014	Contre saison 2014
Vente 1 : pour le remboursement du crédit						
Vente 2 : ne servant pas à rembourser le crédit						

Les possibilités de réponse sont : négociation (avec un banabana), contrat de production, contrat de commercialisation, autre (précisez)

(3) En contre saison 2014, pourquoi est-ce que l'OP a choisi ce type de vente (détailler la réponse)?

- Vente 1 : ……

……

- Vente 2 : ……

……

(4) Qui au sein de l'OP a décidé du mode de vente pour rembourser le crédit en contre saison 2014 (mettre une croix)?

Le président	Les autres membres du bureau	Quelques producteurs qui ne sont pas membres du bureau	Tous les producteurs

(5) Est-ce que l'OP avait le droit de prendre un crédit à la CNCAS en contre saison 2014 = Est-ce que l'OP a bénéficié de la dernière annulation de la dette auprès de la CNCAS? □ Oui ; □ Non

Commentaire du répondant :……

(6) Si oui, est ce que l'OP a utilisé un crédit de la CNCAS en contre saison 2014 □ Oui ; □ Non

(7) La perception des risques par le président de l'OP

	Avec la vente collective par négociation à un banabana…	Avec la vente par contrat de commercialisation	Avec la vente par contrat de production	Avec la vente individuelle à un banabana
Concernant le crédit à la CNCAS				
A. Il est difficile d'obtenir un crédit pour financer la culture du riz				
B. Le crédit est long à obtenir ce qui risque de retarder le début de la culture				
C. Le taux d'intérêt est élevé				
D. Les producteurs risquent de ne pas pouvoir rembourser le crédit à cause des oiseaux, d'inondations ou d'autres catastrophes naturelles				
E. Si l'OP ne fait pas de contrat, la CNCAS refusera de lui faire un prêt pour la saison suivante				
Concernant les intrants rizicoles (semences, engrais, herbicides…)				
F. Il est difficile de trouver un vendeur de semences, d'engrais ou d'herbicides				
G. Il est difficile de savoir si les semences sont de bonne qualité				
H. Il est difficile de récupérer tôt les semences ou l'engrais pour commencer la culture du riz à temps				
I. Le prix des semences, engrais ou herbicides est élevé				
J. Il est difficile de trouver une moissonneuse batteuse pour faire la récolte				
Avec la vente collective par négociation…				
K. Il est difficile de trouver un acheteur de paddy				
L. L'acheteur ne prend pas tout le stock d'un seul coup				
M. L'acheteur ne prend pas tout le stock s'il y a différentes variétés				
N. L'acheteur de paddy risque de ne pas payer				
O. Le prix de vente du paddy peut changer rapidement				
P. Le prix de vente du paddy risque d'être bas				
Q. Le paddy risque de se dégrader (pluie…) ou d'être volé entre la récolte et la vente				
R. L'acheteur ne récupère pas rapidement le paddy vendu				
S. L'arbitrage entre consommation et vente de paddy est difficile				
T. Les producteurs risquent de garder l'argent et de ne pas rembourser la banque				
U. L'acheteur risque de mettre du temps à payer				
V. L'acheteur de paddy triche pour réduire le prix				
W. Il est difficile de s'entendre avec l'acheteur				
X. Il est difficile de mesurer la qualité du paddy				

Modalités de réponse : 1 = Pas du tout d'accord ; 2 = Pas trop d'accord ; 3 = Un peu d'accord ; 4 = Parfaitement d'accord

4.10 Questionnaire auprès des rizeries

La période de référence est l'année 2014

1. Le questionnaire

(1) Enquêteur et date de l'enquête :
(2) Nom de la rizerie :
(3) Nom, poste et numéro de téléphone du répondant :

2. Equipement

(4) Année de création de la rizerie :
(5) Les lignes de transformation

Année	Marque	Fonctions	Puissance	Débit théorique (paddy)	Débit pratique (paddy)	Rendement en riz	Rendement en son	Prix d'achat	Prix de mise en service

Fonctions : Séchoir = 1 ; Pré-nettoyeur = 2 ; Nettoyeur = 3 ; Décortiqueur = 4 ; Depierreur = 5 ; Blanchisseur = 6 ; Polisseur = 7 ; Calibreur = 8 ; Trieur = 9 ; Autre (préciser) = 10

(6) Les autres équipements

	Quantité	Marque (si véhicules)	Année	Coefficient de réparation	Prix	Mode(s) de financement (%)	Prix si location
Foncier	m²						
Aménagements							
Stock (usine)	m²	Nb sacs :					
Stock (collecte)	m²	Nb sacs :					
Stock (vente)	m²	Nb sacs :					
Batiments administratifs	m²						
Laboratoire							
Camions (collecte)							
Voitures (collecte)							
Camions (livraison)							
Voitures (livraison)							
Générateurs							
Tracteurs							
Gradeurs							
Moissoneuses batteuses							
Bâches							

Modes de financement : Fonds propres = 1 ; Crédit bancaire = 2 ; Subvention = 3 ; Autre (préciser) = 4

Crédit bancaire			
Nom de la banque	Montant du crédit	Durée	Taux d'intérêt

Subvention		
Nom organisation	Nature	Montant FCFA

3. Le fonctionnement
    a. Saisonnalité

(7) Combien de tonnes de paddy l'usine a décortiqué en contre saison 2014 ?..... tonnes.
(8) Combien de tonnes de paddy l'usine a décortiqué en hivernage 2014 ?..... tonnes.
(9) Détail du volume décortiqué :

	Activité (heures par jour)		
	Pic (24h/24)	Normale (8-12h)	Basse (moins de 4h)
Les mois de l'activité Mois en contre saison Mois Hivernage			
Nombre d'équipes			
Jours par mois			
Heures par jour			
Nombre de lignes en fonctionnement			
Tonnes transformées par jour			
Quantité moyenne de paddy en stock			
Quantité moyenne de riz en stock			
Nombre de saisonniers			
Nombre de journaliers			

b. Emploi

Type	Nombre	Salaire mensuel moyen
Direction		
Administratif		
Usine		
Collecte		
Vente		

c. Les approvisionnements

Les accords	Pourcentage du volume annuel transformé
Autoproduction	
Contrat de commercialisation	
Contrat de production	
Achat à producteur par négociation, paiement direct	
Achat à producteur par négociation, paiement à crédit	
Transformation en prestation de service	
Autre :	

d. L'achat direct

(10) Part des volumes achetés qui ne sont pas transportés par la rizerie :
(11) Rayon de collecte en km :
(12) Coût de transport moyen d'un sac (incluant chargement et déchargement) :
(13) Intervalles de prix d'achat d'un sac de paddy de 80kg :

e. Les contrats de production

(14) Nombre d'employés réalisant le suivi des parcelles :
(15) Nombre de déplacements par saison pour le suivi de la parcelle d'un producteur :
(16) Taux de non remboursement en contre saison 2014
(17) Taux de non remboursement en hivernage 2014
(18) Est-ce que la rizerie utilise un crédit bancaire pour financer les contrats de production ?
(19) Si oui, quel est le taux d'intérêt :
(20) Si oui, quel est le montant :

f. Prestation de service :

(21) Cout du décorticage par tonne :

g. La production de paddy par la rizierie

	Contre saison	Hivernage
Superficie cultivée		
Coût à l'hectare (FCFA)		
Production (kg/ha)		

h. Financement

Utilisation d'un crédit bancaire pour le fond de roulement? □ Oui □ Non				
Banque	Montant	Durée	Taux d'intérêt	Nombre de crédit en 2014

i. La maintenance

Nom de l'opération	Prix unitaire	Fréquence (en tonnes de paddy)	Routine ou grosse réparation ?

j. La transformation

(22) Puissance du contrat électrique :
(23) Marque de l'unité de transformation :
(24) Taux de riz entier :
(25) Taux de riz intermédiaire :
(26) Taux de riz brisé :
(27) Taux de fine brisure :
(28) Les intrants de la transformation

Nature des intrants	Unité de mesure	Prix unitaire	Fréquence (en tonnes de paddy)
Lubrifiant			
Sacherie 50 kg			
Sacherie 25 kg			
Sacherie son			

(29) Taxe foncière annuelle
(30) TVA :

4. Les produits vendus

(31) Part du riz parfumé : et prix de vente (préciser l'unité)
(32) Part du riz entier : et prix de vente (préciser l'unité)
(33) Part du riz brisé : et prix de vente (préciser l'unité)
(34) Part de la fine brisure : et prix de vente (préciser l'unité)
(35) Prix de vente du kg de son en hivernage : et part des volumes vendus :
(36) Prix de vente du kg de son en contre-saison : et part des volumes vendus :

(37) Pourcentage des volumes vendus en sacs de 50kg : %
(38) Pourcentage des volumes vendus en sacs de 25kg : %
(39) Pourcentage des volumes vendus en sacs de 5kg : %

(40) Ou est livré le riz ? □ Carreau usine ; □ Au local de l'acheteur
(41) Si local de l'acheteur, quelle est la principale destination :
(42) Quel est le coût de transport moyen d'une tonne de riz (incluant chargement et déchargement)?
(43) Ou est livré le son ? □ Carreau usine ; □ Au local de l'acheteur
(44) Si local de l'acheteur, quelle est la principale destination :
(45) Combien est le coût de transport moyen d'une tonne de son (incluant chargement et déchargement) ?

4.11 Questionnaire auprès des décortiqueuses villageoises

La période de référence concerne les deux campagnes rizicoles de 2014 : contre saison et hivernage. Pour la transformation, nous nous intéressons à la période entre Juin 2014 et Mai 2015.

(1) Numéro de questionnaire
(2) Enquêteur : et date de l'enquête
(3) Nom du répondant et numéro de téléphone
(4) Lieu de l'enquête :

1. Organisation du transformateur

(5) Date de création de l'entreprise :
(6) Membre d'une association de transformateurs : □ Oui □ Non
(7) Marque du riz : □ Riz de la vallée ; □ Autre :……..
(8) Quantité de paddy transformée en contre saison 2014 (en tonnes ou nombre de sacs) :…….
(9) Quantité de paddy transformée en hivernage 2014 (en tonnes ou nombre de sacs) :…….

Les accords	Pourcentage	Nombre de sacs	Prix d'achat d'un sac de 80kg
Achat à producteur, paiement immédiat			
Achat à producteur, paiement à crédit			
Achat à producteur, paiement en avance			
Transformation prestation de service			
Autoproduction			
Autre :……..			

2. Equipement :

(10) Fonctions de la décortiqueuse ? □ Décortiqueur ; □ Trieur ; □ Autre (préciser) :
(11) Est-ce que les enveloppes du paddy sont inclues dans le son que vous produisez ? □ Oui □ Non
(12) Combien d'heures de travail dans une journée continue ?.....
(13) Combien de sacs de paddy transformés en une journée continue ?.....

	Nombre	Prix d'achat	Coût d'installation	Année d'achat	Durée de vie	Mode de financement*	Si location, quel est le prix (préciser l'unité)?
Décortiqueur							
Moteur							
Local							
Camion							
Couseuse							
Bâche							
Ventilateur							
Trieur							
Autre							

* Modes de financement : Autofinancement = 1 ; Subvention = 2 ; Crédit bancaire = 3 ; Crédit autre (préciser) = 4

Crédit				
Nature de l'achat	Nom de la banque	Exigible	Durée	Taux d'intérêt

Subvention		
Nature de l'achat	Nom organisation	Montant (FCFA)

(14) Quelle est la marque du décortiqueur (l'enquêteur doit prendre une photo) :
(15) Energie : □ Electricité ; □ Gasoil ; □ Autre (préciser) :…….
(16) Si électricité, quel est la puissance souscrite dans le contrat électrique (KwH):
(17) Si gasoil, quelle est la consommation horaire en litres :……..
(18) Combien de sacs peuvent être décortiqués en une heure quand l'activité est continue ?.....

3. Les dépenses :
    a. La production en 2014

	Contre saison	Hivernage
Superficie cultivée		
Coût à l'hectare		
Nombre de sacs pour toute la superficie		

    b. L'achat direct

(19) Part (%) des volumes achetés qui sont transportés par la rizerie :
(20) Rayon de collecte en km :
(21) Coût de transport moyen d'un sac (incluant chargement et déchargement) :
(22) Utilisation d'un crédit bancaire pour l'achat de paddy? □ Oui □ Non

Montant	Durée	Taux d'intérêt	Nombre de crédit en 2014

    c. Charges d'exploitations

(23) Montant annuel de l'impôt :

(24) Coût de séchage d'un sac de paddy :
(25) Part des sacs de paddy dont le séchage est payé par le transformateur

(26) Combien est payé un salarié saisonnier (par mois) ?
(27) Combien est payé un salarié journalier (par jour) ?
(28) Combien de pot de graisse utilisez-vous par mois ?
(29) Combien coûte un pot ?
(30) Sacherie (prix d'un sac de 25kg) :
(31) Sacherie (prix d'un sac de 50kg) :

Réparations		
Type de réparation	Coût unitaire (matériel et main d'oeuvre)	Fréquence
Roulement		par saison
Tamiseur		
Courroie		par saison
Coure		
Mélangeur		par saison
Autre		par saison

4. Les revenus :

(32) Prix du décorticage par sac (prestation de service):

(33) Quels types de riz produisez-vous ?

Riz entier	Riz brisé	Fine brisure	Riz intermédiaire
%	%	%	%

(34) Est-ce que la plupart de vos clients sont réguliers ? □ Oui □ Non

(35) Part du volume totale de riz vendu en sacs de 50kg : %

(36) Vendez-vous des sacs de paddy vide (sacherie)? □ Oui □ Non

(37) Si oui, combien est vendu un sac de paddy vide ?

(38) Si oui, pourcentage des sacs de paddy vides vendus :

(39) Combien de sacs de riz composent une vente en général (intervalle)?

(40) Quel est le poids d'un sac de son que vous vendez?

(41) Ou est livré le riz ? □ Carreau usine ; □ Au local de l'acheteur ; □ Autre (préciser) :

(42) Si local de l'acheteur, quelle est la principale destination (ville):

(43) Si local de l'acheteur, quel est le coût de transport moyen d'une tonne de riz (incluant chargement et déchargement)?

(44) Ou est livré le son ? □ Carreau usine ; □ Au local de l'acheteur ; □ Autre (préciser) :

(45) Si local de l'acheteur, quelle est la principale destination :

(46) Si local de l'acheteur, quel est le coût de transport moyen d'une tonne de son (incluant chargement et déchargement)

4.12 Questionnaire auprès des grossistes, demi-grossistes et importateurs

La période de référence concerne les deux campagnes rizicoles de 2014 : contre saison et hivernage. Pour le commerce, nous nous intéressons à la période entre Juin 2014 et Mai 2015. Nous nous intéressons au riz produit dans la vallée du Fleuve Sénégal uniquement.

(1) Numéro de questionnaire
(2) Enquêteur : date de l'enquête / / et adresse :
(3) Nom du répondant et numéro de téléphone

a. Organisation

(4) Année du début de l'activité :
(5) Marques du riz local qui sont commercialisée:
(6) Part du riz produit dans la vallée du fleuve Sénégal dans le volume total commercialisé
(7) Part du volume décortiqué par une DV dans le volume total du riz commercialisé issu de la vallé de Fleuve Sénégal
(8) Part du volume décortiqué par une rizerie industrielle dans le volume total du riz commercialisé issu de la vallé de Fleuve Sénégal
(9) Si >0%, préciser le(s) nom(s) :

(10) Pourcentages des types de riz vendus

Riz entier	Riz brisé	Fine brisure
%	%	%

(11) Pourcentages des volumes de riz par conditionnement :

50kg	25kg	5kg
%	%	%

(12) Utilisation d'un crédit bancaire pour l'achat de paddy? □ Oui □ Non

Banque	Montant	Durée	Taux d'intérêt

b. Transport et stockage

(13) Pourcentages des volumes du riz de la vallée par mode de transport utilisés :
Prestation de service % ; Utilisation d'un véhicule possédé % ; Autre (précisez) : : %
(14) Si utilisation d'un véhicule possédé, quel est le type et l'année d'acquisition ?
(15) Si oui, mode de financement :
(16) Si prestation de service, coût de transport moyen d'un sac ou d'une tonne (incluant chargement et déchargement) :
(17) Possédez-vous le local ou vous stockez le riz ? □ Oui □ Non
(18) Si oui, quelle est la surface du local et en quelle année l'avez-vous acheté ?
(19) Si oui, mode de financement :
(20) Si non, quel est le prix de la location mensuelle ?
(21) Combien de jours gardez-vous un sac de riz Sénégalais entre le moment de l'achat et celui de la vente ?
(22) Combien de salariés permanents avez-vous ?

c. Vente

(23) Quelle est votre marge (FCFA) sur un sac de riz (ou une tonne) ?.....FCFA/

(24) Qui sont vos principaux clients ? □ Demi grossistes ; □ Détaillants ; □ Particuliers ; □ Hôtel et restaurants ; □ Entreprises ; □ Etablissements publics ; □ Autre (précisez) :

(25) Organisez-vous le transport du riz que vous vendez ? □ Oui □ Non

(26) Si oui, pourcentages des volumes du riz de la vallée par mode de transport utilisé : Prestation de service % ; Utilisation d'un véhicule possédé % ; Autre (précisez) : : %

(27) Combien de sacs de riz composent une vente en général (intervalle)?

(28) Si utilisation d'un véhicule possédé, est ce que l'achat de ce véhicule a été financé à crédit ? □ Oui □ Non

(29) Quelles sont vos principales contraintes pour l'expansion de votre activité ?.....
……
……

(30) A votre avis, comment sera votre activité dans 5 années ?……..
……
……

d. Saisonnalité de l'activité

(31) Quelle quantité avez-vous vendu entre Juin 2014 et Mai 2015 ?..... tonnes

	Hivernage			Contre saison		
	Juin-Juillet	Aout - Sept	Oct - Nov	Dec - Janv	Fev - Mars	Avril-Mai
Prix d'achat d'un sac de riz brisé (50kg)						
Prix de vente d'un sac de riz brisé (50kg) pour le prix d'achat à la même période						
Prix d'achat d'un sac de riz entier (50kg)						
Prix de vente d'un sac de riz entier (50kg) pour le prix d'achat à la même période						
Nombre de travailleurs saisonniers et/ou journaliers						
Durée moyenne (en jours) pour l'achat, la transformation et la vente d'un sac						
Quantité mensuelle du riz de la vallée						

(32) Montant annuel de l'impôt :

4.13 Questionnaire auprès des détaillants

La période de référence concerne les deux campagnes rizicoles de 2014 : contre saison et hivernage. Pour le commerce, nous nous intéressons à la période entre Juin 2014 et Mai 2015. Nous nous intéressons au riz produit dans la vallée du Fleuve Sénégal uniquement.

(1) Numéro de questionnaire
(2) Enquêteur : date de l'enquête / / et adresse :
(3) Nom du répondant et numéro de téléphone

a. Organisation

(4) Année du début de l'activité :
(5) Que pensez-vous de la qualité du riz de la vallée du fleuve Sénégal
(6) Marques du riz local:
(7) Part du riz importé dans le volume total commercialisé
(8) Part du riz produit dans la vallée du fleuve Sénégal dans le volume total commercialisé
(9) Part du volume décortiqué par une DV dans le volume total du riz commercialisé issu de la vallé de Fleuve Sénégal
(10) Part du volume décortiqué par une rizerie industrielle dans le volume total du riz commercialisé issu de la vallé de Fleuve Sénégal
(11) Si >0%, préciser le(s) nom(s) :

(12) Pourcentages des types de riz vendus

Riz entier	Riz brisé	Fine brisure
%	%	%

b. Transport et stockage

(13) Coût de transport moyen d'un sac ou d'une tonne (incluant chargement et déchargement) :
sac ou tonne
(14) Volume occupé par le stockage du riz : mètre cube
(15) Combien de jours gardez-vous un sac de riz Sénégalais entre le moment de l'achat et celui de la vente ?

c. Vente

(16) Quelle est votre marge (FCFA) sur un sac de riz (ou une tonne) ?.....FCFA
(17) Qui sont vos principaux clients ? □ Demi grossistes ; □ Détaillants ; □ Particuliers ; □ Hôtel et restaurants ; □ Entreprises ; □ Etablissements publics ; □ Autre (précisez) :
(18) Organisez-vous le transport du riz que vous vendez ? □ Oui □ Non
(19) Si oui, pourcentages des volumes du riz de la vallée par mode de transport utilisé :
Prestation de service % ; Utilisation d'un véhicule possédé % ; Autre (précisez) : %
(20) Combien de sacs de riz composent une vente en général (intervalle)?
(21) Si utilisation d'un véhicule possédé, financement à crédit ? □ Oui □ Non

(22) Quelles sont vos principales contraintes pour l'expansion de votre activité ?.....
……
……

(23) Comment sera votre activité dans 5 années ?……..
……
……

d. Saisonnalité de l'activité

(24) Quelle quantité avez-vous vendu entre Juin 2014 et Mai 2015 ?..... tonnes

	Hivernage			Contre saison		
	Juin-Juillet	Aout - Sept	Oct - Nov	Dec - Janv	Fev - Mars	Avril-Mai
Prix d'achat d'un sac de riz brisé (50kg)						
Prix de vente d'un sac de riz brisé (50kg) pour le prix d'achat à la même période						
Prix d'achat d'un sac de riz entier (50kg)						
Prix de vente d'un sac de riz entier (50kg) pour le prix d'achat à la même période						
Nombre de travailleurs saisonniers et/ou journaliers						
Durée moyenne (en jours) pour l'achat, la transformation et la vente d'un sac						
Quantité mensuelle du riz de la vallée						

5. Résumé de la thèse

Chapitre 1 : introduction

La littérature des années 90 en économie et géographie décrit pour l'Afrique et l'Asie des chaînes de valeur alimentaires domestiques souvent qualifiées de traditionnelles. Les acteurs utilisent des techniques faiblement capitalistiques, réalisent des transactions liées et génèrent une faible valeur ajoutée.

La crise des prix de 2007/2008 a relancé le débat sur la contribution des chaînes de valeur domestiques aux objectifs nationaux de sécurité alimentaire et de lutte contre la pauvreté. En Inde, au Bengladesh et en République Populaire de Chine, les politiques d'investissement dans les infrastructures ainsi que la demande pour des produits de qualité ont favorisé la modernisation des chaînes de valeur domestiques. Dans les chaînes de valeur du riz et de la pomme de terre, le segment intermédiaire (riziers et entrepôts de stockage) a investi dans de nouvelles techniques de décorticage et de stockage, et a intégré la fonction de collecte des produits agricoles. Ces transformations permettent une amélioration de la qualité du produit final, une baisse des prix pour les consommateurs et parfois une amélioration du revenu des producteurs.

Le contexte africain est aussi favorable à la modernisation de certaines chaînes de valeur alimentaires domestiques. La demande pour des produits de qualité est croissante, et les politiques publiques ont pour objectif de moderniser ces chaînes de valeur afin d'améliorer l'autosuffisance des pays. Pour cela, elles accompagnent l'intensification de la production et l'amélioration de la connexion des producteurs aux marchés urbains. Quelques travaux documentent des investissements à grande échelle dans la production et la transformation, et une coordination par contrats entre les agrobusiness et les producteurs familiaux. Néanmoins, ils sont encore rares.

Cette thèse traite trois questions, chacune correspondant à un article :

1. Dans quelle mesure la modernisation asiatique des chaînes de valeur domestiques peut-elle être observée en Afrique ?
2. Quels sont les déterminants de la combinaison de la vente de produits agricoles par contrats et par transactions spots ?
3. Quels sont les impacts des contrats dans une chaîne de valeur domestique de produits céréaliers sur les revenus et la sécurité alimentaire des petits producteurs ?

Le cadre conceptuel est celui de la gouvernance des chaînes de valeur, qui analyse l'influence d'un acteur pilote sur la qualité du produit final, sur la répartition des fonctions entre les acteurs et sur la distribution de la valeur dans la chaîne. La gouvernance prend des formes intermédiaires entre le marché et la hiérarchie et le concept de mise à niveau permet de comprendre si des changements techniques et organisationnels

permettent à des producteurs d'accéder à des marchés plus rémunérateurs. Dans le second article, je mobilise aussi le cadre théorique des moyens d'existence qui permet d'analyser l'inclusion des producteurs en fonction de leurs dotations en capitaux, et la théorie des formes plurielles de gouvernance qui explique la non-convergence des arrangements institutionnels par l'existence de formes d'incertitudes diverses.

Le cas étudié est la chaîne de valeur du riz de la vallée du Fleuve Sénégal, à laquelle participent 45.000 petits producteurs. Le Programme National d'Autosuffisance en Riz, mis en œuvre au Sénégal depuis la crise des prix, vise à améliorer la qualité des produits et à augmenter les volumes fournis par cette chaîne de valeur domestique. L'étude de cette chaîne de valeur permet de comprendre des transformations qui peuvent avoir lieu à l'échelle de l'Afrique de l'Ouest.

L'approche combine des méthodes quantitatives et qualitatives. La collecte de données s'est appuyée sur 154 entretiens semi-directifs avec des parties prenantes. Elle s'est aussi appuyée sur des enquêtes menées auprès de 90 présidents d'organisations de producteurs, de 607 petits producteurs, de 49 transformateurs et de 304 commerçants. Les méthodes de la variable instrumentale et de l'appariement au score de propension sont utilisées pour corriger le biais de sélection. Cinq groupes de discussion furent animés pour présenter et analyser les résultats.

Les principaux résultats de la thèse sont les suivants :

1. La dynamique de modernisation au Sénégal est similaire à celle observée en Asie. Néanmoins, la situation de référence est différente, la politique de crédit contribue directement au changement de gouvernance et la chaîne de valeur moderne n'est pas compétitive par rapport aux importations.
2. Les producteurs participent à l'agriculture contractuelle pour sécuriser le financement de la riziculture. La segmentation du marché du crédit est liée à l'endettement des producteurs auprès de la banque nationale. L'incertitude sur les conditions de la transaction est un déterminant de second ordre de la participation aux contrats.
3. Le contrat de commercialisation n'a pas d'impact sur les pratiques agricoles, les rendements, la qualité du produit et le revenu des producteurs. Néanmoins, il améliore légèrement leur sécurité alimentaire par le biais de la stabilisation du prix de vente. Le contrat de production a un impact positif sur le revenu des producteurs exclus du crédit de la banque agricole nationale mais il inclut des coûts implicites d'intérêt et d'assurance qui provoquent un plus faible revenu de ces producteurs par rapport à ceux financés par la banque nationale.

Chapitre 2 : la modernisation de la chaîne de valeur du riz au sénégal est-elle similaire à la révolution asiatique ?

Nous analysons les dynamiques de la chaîne de valeur du riz du Sénégal afin de déterminer si elles ressemblent aux transformations observées en Asie. Nous mobilisons le cadre théorique des chaînes de valeur. La performance des chaînes de valeur est estimée en termes de compétitivité vis-à-vis des importations, particulièrement en termes de qualité, de volume, de coûts de production, de marges et de prix final. Nous avons réalisé des entretiens qualitatifs avec 154 parties prenantes de la chaîne de valeur. Les analyses quantitatives se basent sur l'enquête de 913 acteurs de la chaîne.

Depuis 1964, les politiques publiques et le lien au marché international ont influencé la gouvernance de la chaîne de valeur. Le gouvernement est d'abord intervenu directement dans la chaîne de valeur par le biais d'agences réalisant le décorticage et la commercialisation du riz. Les politiques de libéralisation mises en œuvre dans les années 90 ont ensuite favorisé le développement d'unités de décorticage opérant à petite échelle et à bas coûts. La croissance de la demande pour un riz de qualité ainsi que l'augmentation des prix sur les marchés internationaux entre 2008 et 2014 ont été favorables à la modernisation de la chaîne de valeur du riz. Les transformateurs ont investi dans des techniques à plus hauts rendements qui réalisent des fonctions améliorant la qualité du produit final. Des formes de coordination tendant vers l'intégration verticale visent à sécuriser leurs approvisionnements de paddy. La marge sur le riz a augmenté. Nous trouvons donc que la modernisation de la chaîne de valeur du riz du Sénégal est similaire à celle observée en Asie. Néanmoins, la modernisation au Sénégal présente trois différences. (1) La situation de référence est une transaction spot avec une tendance relationnelle (et non une transaction liée), et les transformateurs réalisaient la collecte du paddy avant la modernisation. (2) La politique de crédit contribue directement à la tendance de la gouvernance vers l'intégration verticale. (3) La modernisation de la chaîne de valeur ne la rend pas compétitive par rapport aux importations.

La modernisation rencontre des difficultés pour passer d'une phase d'amélioration de la qualité du riz à celle d'augmentation des volumes transformés par les unités industrielles. Les volumes que ces unités collectent sont limités à ceux fournis par les producteurs pour rembourser leurs crédits. La transformation de faible volume génère de hauts coûts d'amortissement. En parallèle, les transformateurs à petite échelle opèrent à bas coûts mais rencontrent des contraintes de technique et de fond de roulement. Afin d'améliorer la compétitivité de la chaîne de valeur, nous recommandons l'inclusion de ces petits transformateurs dans la modernisation par la promotion de techniques de décorticage semi-industrielles, et l'ouverture de lignes de crédit à l'investissement et au fonctionnement. Nous recommandons aussi la réalisation d'études à propos de l'utilisation de mécanisation agricole à petite échelle.

Chapitre 3 : formes plurielles de gouvernance et financement agricole : le cas de la chaîne de valeur domestique du riz du Sénégal

L'inclusion des petits producteurs dans l'agriculture contractuelle peut avoir d'importantes implications en termes de développement. Mais elle a surtout été documentée dans le cas de chaînes de valeur d'exportation. De plus, la littérature sur l'agriculture contractuelle considère que les producteurs sont soit inclus dans une chaînes de valeur traditionnelle par des transactions spots (avec une tendance relationnelle), soit inclus dans une chaîne de valeur moderne par le biais de contrats. Néanmoins, la stratégie de commercialisation des producteurs consiste parfois à combiner les deux.

Dans cet article, nous questionnons les déterminants de la combinaison de types de ventes par les petits producteurs. Le cadre conceptuel analyse l'influence des moyens d'existence et de l'incertitude sur l'apparition de formes plurielles de gouvernance. Le cas étudié est celui des petits producteurs du Sénégal, qui commercialisent le paddy par des transactions spots, des contrats de commercialisation et des contrats de production. Basé sur un échantillon de 372 observations, un modèle logit multinomial permet d'identifier les variables déterminantes de la pluralité.

Depuis l'indépendance, la politique de crédit mise en œuvre par le gouvernement soutient le développement de la chaîne de valeur. La banque agricole nationale réalise des prêts aux organisations de producteurs. Ces producteurs réalisent des ventes spots collectives pour rembourser le crédit et des ventes spots individuelles en fonction des besoins du ménage. Mais cette banque a subi plusieurs plans de redressement du fait de faibles remboursements. De plus, la politique de modernisation de la chaîne de valeur vise à sécuriser les approvisionnements des riziers. La mise en place de contrats est réalisée dans le but d'assurer le remboursement du crédit et les approvisionnements des transformateurs.

Les contrats sont réalisés en complément des ventes spots individuelles, et remplacent la vente collective par transaction spot visant à rembourser le crédit. Le capital financier de l'exploitation est le principal déterminant de la pluralité de la gouvernance. La perception de l'incertitude par les producteurs est le second déterminant. Les producteurs ayant accès au crédit de la banque nationale ont plus de chance de réaliser un contrat de commercialisation, en particulier lorsqu'ils perçoivent une incertitude sur l'accès au crédit. Les producteurs exclus du crédit de la banque nationale ont plus de chance de réaliser un contrat de production. Les producteurs diffèrent par leur capital financier et leur perception de l'incertitude, et la segmentation du marché du crédit est réalisée en lien avec l'endettement des producteurs.

Chapitre 4: impacts de l'agriculture contractuelle sur les revenus et la sécurite alimentaire des producteurs: le cas de la chaîne de valeur domestique du riz au sénégal

La littérature traitant de l'agriculture contractuelle met en évidence la mise à niveau des producteurs par le biais de l'accès à des intrants améliorés, à du conseil technique et à des marchés à forte valeur ajoutée. Mais les impacts de l'agriculture contractuelle doivent encore être questionnés car peu de recherches s'intéressent aux chaînes de valeur domestiques de céréales, aux impacts sur la sécurité alimentaire des producteurs et à la combinaison de formes de commercialisation.

Nous testons l'hypothèse que les contrats dans une chaîne de valeur domestique de céréales améliorent les revenus et la sécurité alimentaire des producteurs. L'effet sur le revenu opère par le biais de l'accès au crédit, aux intrants améliorés et au conseil technique. L'effet sur la sécurité alimentaire opère par le biais du revenu. Nous étudions la chaîne de valeur du riz du Sénégal, où la banque agricole nationale soutient la mise en œuvre de contrats de commercialisation, et où les riziers mettent en place des contrats de production. Nous mobilisons une base de données de 594 producteurs impliqués dans des contrats et des transactions spots. Nous utilisons des modèles à variable instrumentale et d'appariement au score de propension afin de corriger le biais de sélection.

Nous trouvons que le contrat de commercialisation n'a pas d'effet sur le revenu car il ne modifie pas les pratiques agricoles, les rendements, la qualité du paddy et le prix de vente. Il s'agit d'une innovation institutionnelle qui vise à assurer le remboursement des crédits à la banque nationale et à sécuriser les approvisionnements des riziers. Néanmoins, ce contrat réduit légèrement l'insécurité alimentaire car il atténue la saisonnalité des prix. Le contrat de production génère un effet positif sur le revenu des producteurs qui sont exclus de la banque agricole nationale et qui n'ont pas d'autre moyen de financer la riziculture. Néanmoins, ces producteurs ont des revenus moins importants que ceux des producteurs bénéficiant d'un crédit de cette banque. En effet, le contrat de production inclut un taux d'intérêt potentiellement élevé du fait de la structure oligopolistique de ce segment du marché du crédit, et une prime d'assurance élevée liée à la caractéristique d'endettement des producteurs à la banque nationale.

Nous recommandons l'appui de la recherche au développement d'un système d'assurance de crédit agricole. Nous recommandons aussi l'intégration de la négociation du prix d'achat des contrats de production au sein de l'interprofession, avec l'analyse de ses différentes composantes.

Chapitre 5 : conclusion

En Asie, certaines chaînes de valeur alimentaires sont en cours de modernisation. Le segment intermédiaire investit dans de nouvelles techniques et intègre la fonction de collecte. Ces transformations permettent une amélioration de la qualité du produit final, une baisse des prix pour les consommateurs et parfois une amélioration du revenu des producteurs.

En Afrique, suite à la crise des prix, les politiques agricoles visent à moderniser les chaînes de valeur alimentaires domestiques. L'objectif de cette thèse est de documenter la transformation des chaînes de valeur domestiques en Afrique et ses effets sur les producteurs. Le cadre conceptuel est celui de la gouvernance des chaînes de valeur, qui analyse l'influence d'un acteur pilote sur la qualité du produit final, sur la répartition des fonctions entre les acteurs et sur la distribution de la valeur. Le cas étudié est la chaîne de valeur du riz de la vallée du fleuve Sénégal. Les analyses s'appuient sur 154 entretiens semi-directifs et l'enquête de 90 présidents d'organisations de producteurs, de 607 petits producteurs, de 49 transformateurs et de 304 commerçants. Les méthodes de la variable instrumentale et de l'appariement au score de propension sont utilisées pour corriger le biais de sélection.

La première hypothèse est que, comme en Asie, la gouvernance de la chaîne de valeur du riz du Sénégal tend vers l'intégration sous l'impulsion du segment intermédiaire. Cette hypothèse est validée bien que l'on observe des différences avec le cas asiatique. Premièrement, du fait de l'existence depuis 1964 d'une politique de crédit, la situation de référence au Sénégal est une transaction spot avec une tendance relationnelle, et non une transaction liée. De plus, les transformateurs réalisaient la collecte du paddy avant la modernisation. La seconde différence est qu'au Sénégal la politique de crédit contribue directement au changement de gouvernance par la mise en place de contrats de commercialisation visant à sécuriser les approvisionnements des riziers et le remboursement du crédit. La troisième différence est que la modernisation n'est pas compétitive par rapport aux importations de riz brisé. Les faibles volumes collectés par les riziers génèrent un coût d'amortissement élevé. L'intervention de l'Etat permet aux riziers de continuer leur activité mais l'amplitude de la modernisation est limitée.

La seconde hypothèse est que l'existence de formes plurielles de gouvernance est expliquée par le capital financier et la stratégie de réduction de l'incertitude des producteurs. Cette hypothèse est validée. Les exploitations rizicoles sont spécialisées et ont pour principale opportunité de financement extérieur le crédit de la banque agricole nationale. Les producteurs qui ont accès au crédit de cette banque ont plus de chances de participer à un contrat de commercialisation, surtout lorsqu'ils perçoivent une incertitude sur l'accès au crédit, sur les débouchés et sur la fluctuation du prix de vente. Les producteurs exclus du crédit bancaire ont plus de chance de participer à un contrat de production. Ainsi, les producteurs participent aux contrats afin

de sécuriser le financement de la riziculture. En complément, ils réalisent des transactions spots qui sont adaptables aux besoins du ménage. La segmentation du marché du crédit est donc liée à l'endettement des producteurs auprès de la banque nationale. L'incertitude est un déterminant de second ordre.

La troisième hypothèse est que (1) les contrats augmentent les revenus des producteurs par le biais de l'accès à des intrants et du conseil technique qui améliorent la qualité des produits et les rendements, et que (2) les contrats améliorent la sécurité alimentaire des producteurs par le biais du revenu. Cette hypothèse est partiellement validée. Le contrat de commercialisation n'a pas d'impact sur les pratiques agricoles, les rendements, la qualité du produit et le revenu des producteurs, mais il améliore légèrement leur sécurité alimentaire par le biais de la stabilisation du prix de vente. Le contrat de production a un impact positif sur le revenu des producteurs exclus du crédit de la banque agricole nationale mais il inclut des coûts implicites d'intérêt et d'assurance qui empêchent ces producteurs de générer autant de revenu que ceux financés par la banque nationale.

Le chapitre en annexe teste l'hypothèse que la combinaison de la coordination verticale et d'investissements à grande échelle réduit la participation des petits producteurs dans la gestion de ressources agricoles du territoire. Il montre que le changement de gouvernance territoriale dépend de la prise en compte des institutions coutumières et des mécanismes légaux de contrôle et d'application des accords. Toutefois, en dépit d'une gouvernance territoriale qui leur est moins favorable, une partie des producteurs familiaux accepte l'arrivée des AB car ils fournissent certaines infrastructures socio-économiques de base. Ce chapitre teste aussi l'hypothèse que les effets des investissements d'agrobusiness sur l'accès au foncier, les pratiques agricoles, la sécurité alimentaire et les revenus varient en fonction des types de producteurs. Les données montrent que les riziculteurs bénéficient d'une augmentation des surfaces cultivées. Au contraire, les agropasteurs voient réduire leur accès à l'eau, aux espaces de pâturage et au foncier pluvial. De plus, le contrôle hiérarchique de la production agricole augmente l'intensité culturale.

Ces résultats permettent de formuler trois recommandations. Premièrement, les politiques publiques devraient financer la réalisation d'études visant à comprendre les déterminants du défaut de remboursement des producteurs afin de proposer un système adapté d'assurance du crédit agricole. Elles devraient aussi intégrer la négociation du prix d'achat des contrats de production au sein de l'interprofession, avec la décomposition des coûts implicites de l'intérêt et de l'assurance. Deuxièmement, la compétitivité de la chaîne de valeur moderne peut être améliorée par l'inclusion des petits transformateurs dans la modernisation. L'ouverture de crédit à l'investissement permettrait aux commerçants-transformateurs traditionnels d'acquérir des techniques semi-industrielles opérant à bas coûts et fournissant un riz de qualité. L'ouverture de crédit de fonctionnement augmenterait les volumes qu'ils transforment.

Troisièmement, la réalisation d'études à propos de l'utilisation de mécanisation agricole à petite échelle pourrait contribuer à la réduction des coûts de production.

Cette thèse comporte plusieurs limites. Tout d'abord, les contextes africains et asiatiques peuvent différer en des points qui invalident la justification d'une comparaison. De plus, l'identification de différences entre les modernisations asiatiques et sénégalaises pourrait être liée à l'utilisation de cadres conceptuels différents. D'autre part, il se pourrait que la gouvernance de l'aval de la chaîne de valeur du riz du Sénégal influence celle en amont, ou que les organisations de producteurs diffèrent par leurs actions collectives. Une autre limite du travail est la représentativité limitée du cas Sénégalais par rapport au reste de l'Afrique de l'Ouest. En effet, le principal produit consommé est le riz brisé qui est un sous-produit sur le marché international. De plus, les pratiques agricoles dans la vallée du fleuve Sénégal sont intensives, ce qui n'est pas partout le cas en Afrique de l'Ouest. Enfin, la méthodologie est limitée puisqu'elle est basée sur des enquêtes en coupe transversale. L'année de référence présente certaines spécificités qui pourraient réduire la validité externe des résultats. De plus, la participation dans les contrats est un phénomène qu'il est préférable d'analyser en dynamique. Enfin, les méthodes d'évaluation d'impact reposent sur l'hypothèse que les groupes comparés sont similaires et que l'ensemble des caractéristiques des producteurs sont observées. Ces hypothèses ne sont pas toujours validées en pratique.

De futures recherches pourraient documenter d'autres cas de transformation des chaînes de valeur domestiques en Afrique de l'Ouest. Elles devraient particulièrement mobiliser des approches comparatives entre filières, se concentrer sur le segment intermédiaire et comparer la performance économique des formes de coordination verticales et horizontales. Des approches dynamiques peuvent être mobilisées pour documenter les effets de ces transformations, en particulier l'inclusion des producteurs, les transformations rurales des territoires et les transformations structurelles des exploitations. Il est aussi nécessaire de plus documenter les impacts en termes de revenu et de sécurité alimentaire mais aussi de nutrition, de genre et de pratiques agricoles. Enfin, il semble nécessaire de développer une approche de la durabilité en tant que modèle générant des tensions entre les ressources et les acteurs des territoires et des filières. L'ensemble des résultats des précédentes et futures recherches doit être diffusé auprès des décideurs politiques, afin de les informer des effets (recherchés et non-recherchés) des politiques publiques.